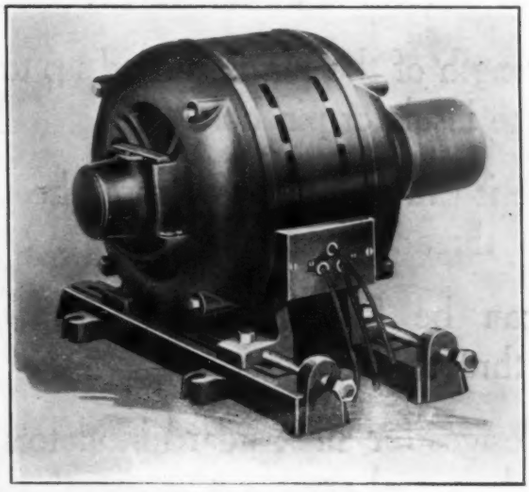
In This Issue *"The Electrical Supply Jobber: Is he a Nuisance or a Necessity?" together with Departmental Discussions of Vital Interest to Engineers throughout the West*

JOURNAL OF ELECTRICITY

VOL. XXXVIII NO. 10 SAN FRANCISCO, MAY 15, 1917 PER COPY, 25 CENTS

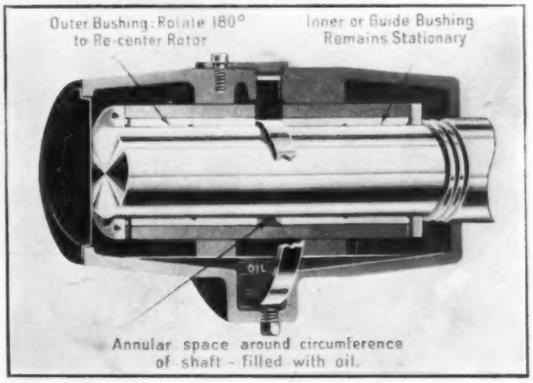
Howell Polyphase Motors

Equipped With Patented Rotor Re-Centering Bearings

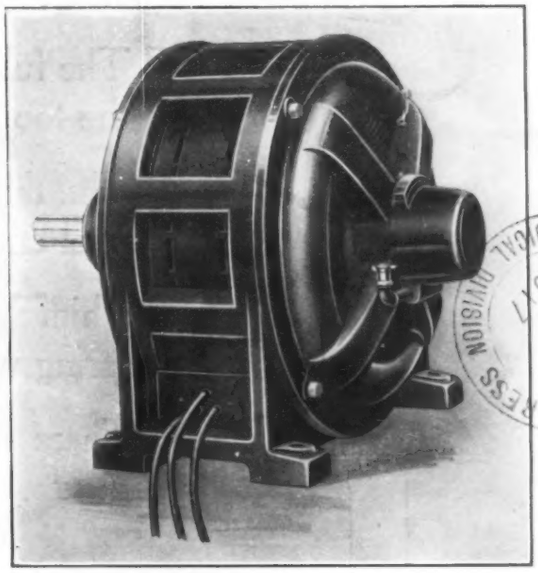


5 H. P. 1800 R. P. M. Type "B" Riveted Frame Motor

Cast end-rings; perfect mechanical and electrical joints, no throwing of solder


Outer Bushing: Rotate 180° to Re-center Rotor
Inner or Guide Bushing Remains Stationary
OIL
Annular space around circumference of shaft - filled with oil.

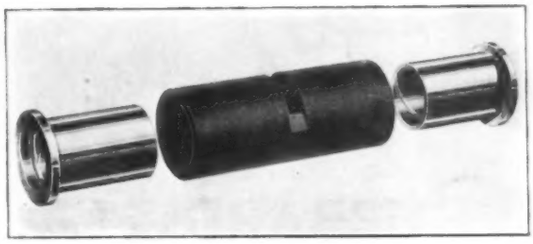
Assembled View of Bearing Showing Location in Housing. Inner and Outer Bushing Refers to Relative Position of Bushing in End Shield



50 H. P. 1200 R. P. M. Type "A" Skeleton Frame Motor

Moisture and waterproof insulation on coils

Large bronze bushings; 100% over size



Unassembled View of Bearing Showing Cylindrical Casing, also Inner and Outer Bushing

Howell Electric Motors Company
GENERAL OFFICE AND FACTORY
HOWELL, MICHIGAN, U. S. A.

GARLAND-AFFOLTER ENGINEERING CO.

Western Distributors

SAN FRANCISCO LOS ANGELES

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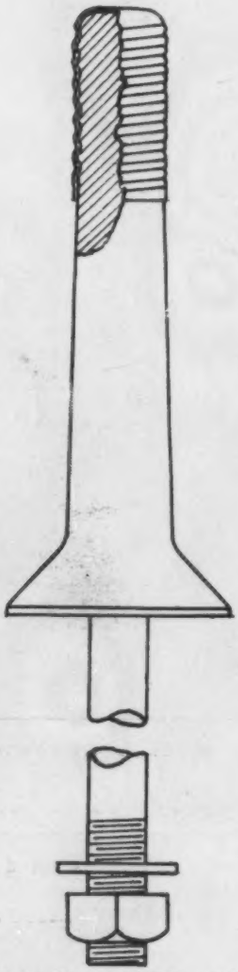
The Hardware Makes The Line

CONTINUITY—*and* HOW?

Peirce Forged Steel Pins Answer the Question



Peirce Forged Steel Pins with Separable Thimble

¶ The pin is a solid forging made from a single block of steel and has neither welds nor joints.

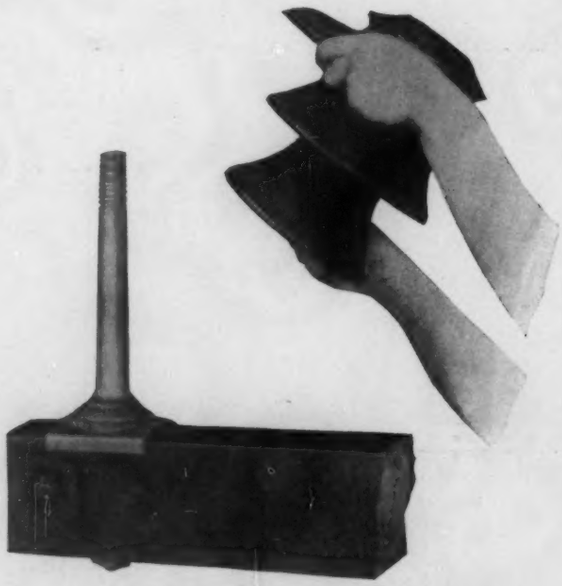
¶ Its strength is uniform in all directions.

¶ The full strength of the pin is carried up to the top of the insulator pin hole.

¶ The thimble is drawn seamless from sheet steel and the threads are pressed.

¶ Thimbles can be furnished with lead or spring wire threads if desired.

¶ There are designs for all standard insulators and for wood or steel arms.



The Pin is Mounted on the Cross Arm, and the Insulator, with Thimble Cemented in, is Ready to be Screwed on.

HUBBARD & CO.
PITTSBURGH, PA.

Distributers for the Pacific Coast
PACIFIC STATES ELECTRIC CO.
Los Angeles Oakland Portland San Francisco Seattle

Hubbard Makes The Hardware

MAY 21 1917
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Devoted to the Generation, Distribution and Utilization of Energy

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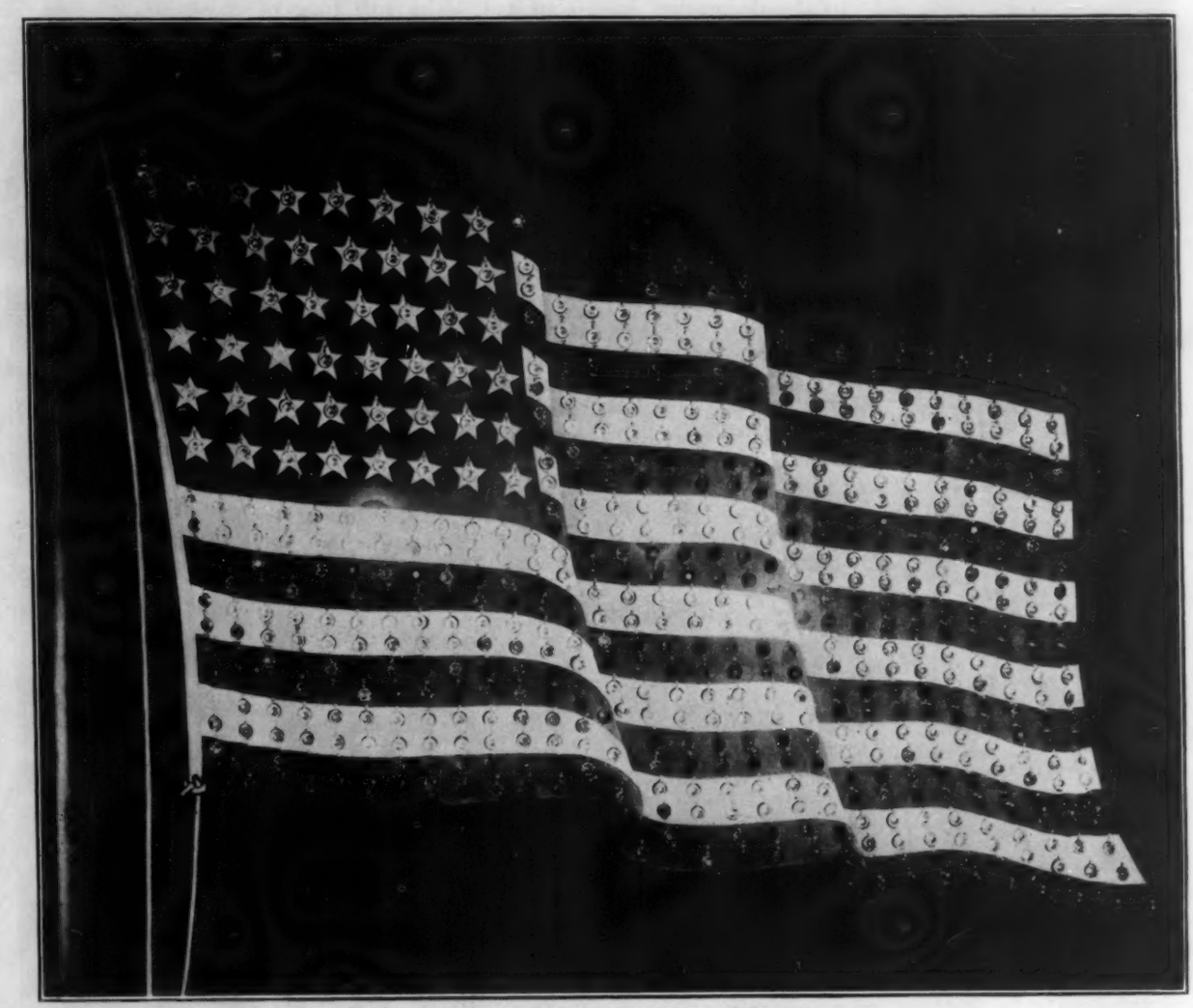
THE ELECTRIC FLAG AND THE NOVAGEM

(The flag, symbolic of all the purity and perfection which we as a nation hold dear and proudly sway to the breeze in order that all peoples may partake of the liberty and democracy that it represents in spiritual significance, is receiving the attention o noted illuminative experts in the study of brilliancy, hitherto unattempted. W. D'A. Ryan, the noted illumination engineer of the Panama-Pacific International Exposition, is producing effects by means of novagems set in the flag that either by sunlight or high powered searchlight bespeak an eloquence that stirs the innermost sentiments when beheld by the observer.—The Editor.)



The National Emblem Studded with Novagems

Those who attended the banquet at the Riverside convention of the Pacific Coast section of the National Electric Light Association will recall the flag of tantalizing beauty that was displayed during the evening's program in the rear of the toastmaster's seat. Its exquisite beauty and fascinating radiancy will long live in the minds of those who beheld it, so great an impression did this emblem make at that gathering.

The flag shown in the illustration is of a slightly larger design than the one exhibited at Riverside. The

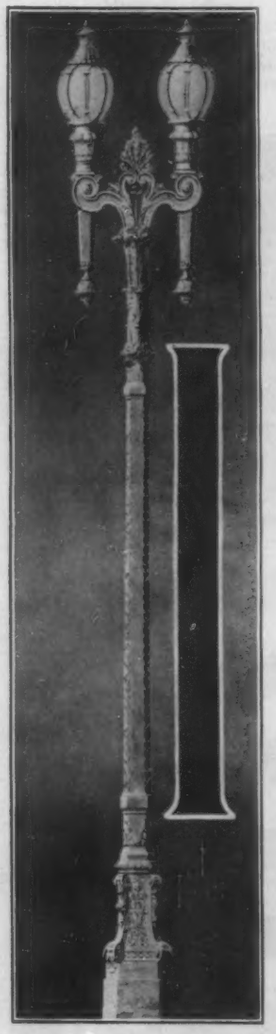
hand cut novagems used are similar to the ones used on the Tower of Jewels at the Panama-Pacific International Exposition. They are suspended so that they may be moved by the wind and also the flag is perforated at each jewel in order that the flag may be effective when the sun hits it from the rear.

At night the effect of the throwing of light rays upon it from a high powered searchlight is difficult of description. Perhaps it may be best described as that flag which appears in consciousness when we endeavor to picture in mind all the nobility and sublimity that this emblem in reality symbolizes.

PROPOSED NEW ILLUMINATION EFFECTS

BY W. D'A. RYAN

(The West has ever played the leading role in evolution of artistic lighting design. In 1905 there was installed in Los Angeles the first ornamental electric street lighting system which consisted of a seven-light standard thirteen and one-half feet in height. This served to advertise Los Angeles the world over. Since then development has been rapid. Two new systems described below are proposed for Los Angeles and San Francisco by the author who is the well-known designer of the beautiful lighting effects for the Panama-Pacific International Exposition.—The Editor.)



Proposed Ornamental Luminous Arc Standard for Broadway Lighting Effect in Los Angeles

N Los Angeles, it is proposed to use two designs of lighting standards alternating in pairs. This will add to the decorative feature and will furnish an additional element of advertising value. The designs are, respectively, the Rose standard and the Spanish Renaissance, both of which are particularly appropriate to Los Angeles. These were executed by Mr. J. W. Gosling, who has been associated with the writer for a number of years, and he also designed the major portion of the lighting standards and units used at the (San Francisco) Panama-Pacific International Exposition. The Los Angeles standards, without question, represent Mr. Gosling's best effort in this particular field.

The system recommended represents the most advanced practice in modern street illumination. The lighting will be lively without excessive intrinsic brilliancy. The arcs will be at an approximate elevation of 25 ft., where they will not interfere with the window lighting or sign lighting either by simultaneous contrast or otherwise, but will soften the general effect. They will add dignity and beauty to the streets by day as well as by night, and the apparent broadening of the streets and sidewalks as compared with the present effect of the globe cluster lights will be most marked. Not only will Los Angeles have a well lighted street surface, but owing to the high co-efficient of reflection of the buildings, the facade and sky line lighting will be unusual.

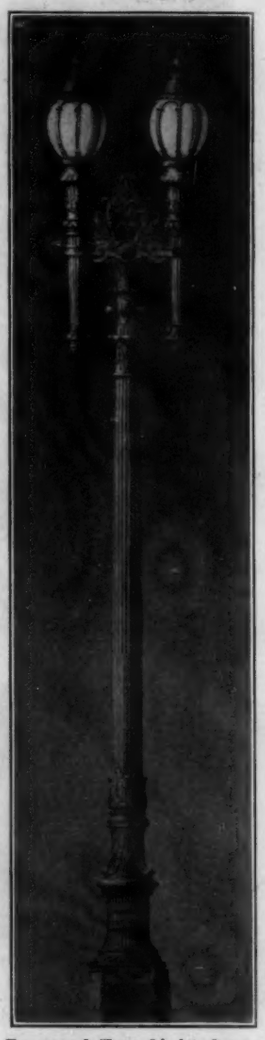
We have aimed to combine modern flood lighting and utilitarian results with a slight suggestion of the Carnival. The soft tone of the glassware specified, will be much less insistent than the present white glassware.

In San Francisco, the business section bounded by Market, Powell, Sutter and Kearny streets, with a block extension on Kearny, is to be known as the Triangle District.

Nearly nine thousand feet of streets are to be lighted in this district with approximately fifteen thousand feet of abutting property. There are to be a total of two hundred and fifty-six lamps. It is recommended that there shall be two 6.6 ampere luminous arc lamps on each standard. These lamps are to be equipped with San Francisco gold carrara glassware.

The definite design of the standard will be determined at a later date. For estimating purposes a suggested design is given which shows the distance to the arc to be 22 ft. This measurement should be maintained.

On the lighting plan certain locations are designated where lamps are to burn all night. All other lamps are to be extinguished at midnight. The present electrolier locations have been chosen in order to utilize the existing laterals. These laterals are one inch pipe and a special cable 7/8 in. in diameter.

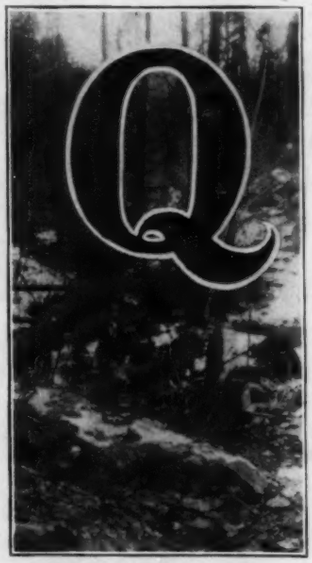


Proposed Two-Light Ornamental Standard for San Francisco Triangle Business District

ECONOMIC DEVICES IN A SMALL HYDRAULIC SYSTEM

BY J. W. SWAREN

(Without the utilization of small hydraulic systems, little hope can be held out for ultimate complete development of latent water powers throughout the West, since such powers in the aggregate constitute gigantic totals in energy units. Here is a description of a small installation that should prove of unusual interest to readers of the Journal in that economizing devices are made use of in a small hydraulic installation that are proving useful and efficient, which augurs much for future extended development of small hydraulic systems. The author is a well-known hydraulic engineer with the Pelton Water Wheel Company.—The Editor.)



Stream at Low Flow with Small Dam for Diversion

QUINCY, California, a town of 500 people, has more than one hundred and sixty electric services, all metered, supplied by an hydroelectric plant on Ganser Creek, a stream with a water shed of three square miles; and a minimum flow of 1.25 sec. ft., extending over several months of summer and autumn.

Although an original installation had been made nearly eighteen years ago, the demand for service had been quiescent, as Quincy is a mining town of the days of hydraulicking. Advent of the railroad, with a large saw mill, and a transient influx during the vacation season, brought about load demands beyond the capacity of the old, belted type generator driven by a hand-governed Pelton wheel.

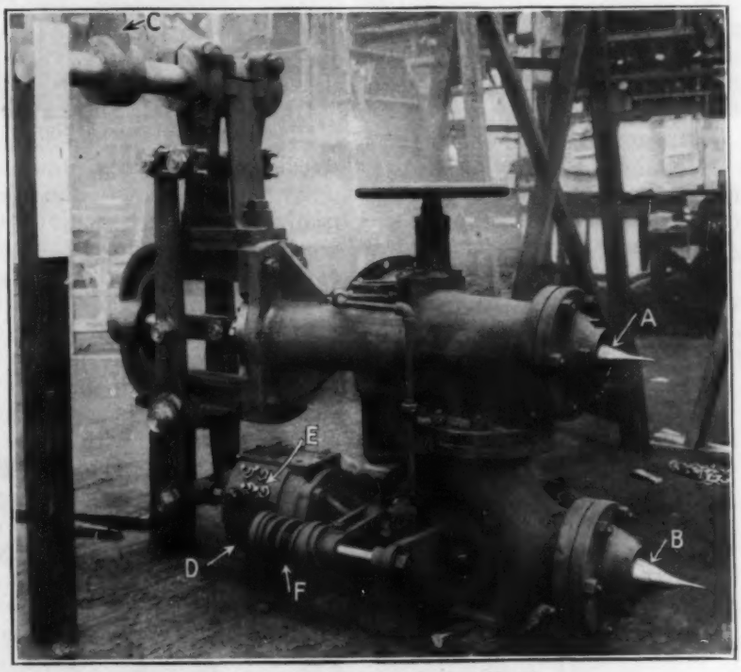
Rumors of competition were heard. The lines of one of the large transmission companies were only 22 miles away. The Christmas, peak of 1914 and summer peak of 1915 reached a value rendering prompt relief imperative, and a general condition existed that would influence the public service commission to look with favor on a competitive application.

While there are a number of water power sites available within a few miles of Quincy, careful investigations indicated the advantage of utilizing Ganser Creek, the stream already in use. This permitted the station to be built just across the street from the residence of H. C. Fluornoy, manager of the Quincy Light & Power Company, and less than half a mile from the load center of the system. Further, the entire water shed of Ganser Creek is owned by the company, while development of any other site would involve purchase from other holders, or permits from the Forest Service.

Small Storage Reservoir Provided 24 Hour Service

At no time does this stream have an excessive flow, as all the slopes of its drainage area are heavily forested. During the summer and early autumn, before the fall rains, and again in early winter, when frost checks the stream flow, the water quantity is very low, some years dropping to 1.25 sec. ft. A brush and gravel dam diverts the entire flow during low water, through a measuring box into a ditch, 300 ft. long, leading to a reservoir with a capacity of 90,000 cu. ft. The dam, stream at low flow, and measuring box are shown in the first illustration.

The reservoir was built by excavating into the canyon bank, with team and scraper, moving the dirt into a dam, 300 ft. long and 16 ft. high at its highest point. The earth was thoroughly packed by the teams, which were driven the full length of the fill, and care was taken to exclude all leaves and sticks. A slope of 2½ to 1 was maintained on the inside, and 1½ to 1 on the outside. This reservoir has been in use several years. No trouble has been experienced with silting, but falling leaves from the surrounding heavy stand of timber have proven a severe annoyance, and it has been found necessary to clean the bottom at least every two years.

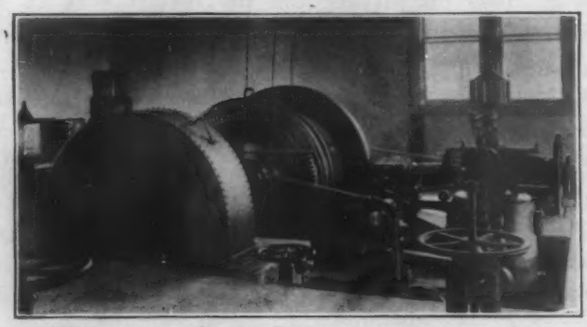


Water Economizing Relief Nozzle

By storing surplus flow during daylight and early morning hours, sufficient water was provided

for carrying the old plant over peak loads. When the new installation was contemplated, additional storage was desired. However, careful examination of the canyon proved that no site was available where a storage dam could be built at a cost justified by increased revenue.

Some consideration was given to a plan of increasing the capacity of the present reservoir slightly, and pumping the flow of a large group of springs bursting out a little lower than the reservoir, and on the opposite side of the canyon. This was planned to utilize power developed by normal stream flow during



Pelton Water Wheel of 140 h.p. with Economizing Devices

off peak hours. While the difference in heads permitted a considerable saving of hydraulic energy, this plan was abandoned because of the expense of building and maintaining a line through heavy timber, the expense of installing a suitable pumping equipment, and its operation.

Water Economizers for Unusual Conditions

A careful analysis of the possibilities of the minimum stream flow, combined with the small storage available, when utilized by a high efficiency water wheel fitted with specially developed economizing devices, indicated that not only could twenty-four hour service be maintained, but that a peak load of 80 kw. could be carried.

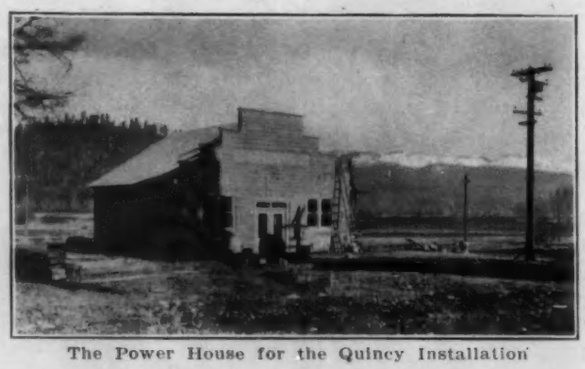
The penstock leading directly from the reservoir is 5100 ft. long, tapering from 22 in. at the reservoir to 10 in. at the power house, where a static head of 360 ft. is available. The power house, Fig. 4, is a concrete block building 38 ft. by 32 ft.

The old water wheel is still in place, to be used in case of an accident to the new unit. But entire operating reliance is placed on a new unit, as shown in the illustration, installed early in 1916. This is a Pelton wheel, rated at 140 h.p., direct connected to a General Electric 3-phase 2300-volt generator rated at 80 kw. at 80 per cent p.f. The water wheel is of the overhung type, with the exciter belt driven from a pulley on the main shaft. A two-panel switchboard controls the electric equipment, a Tirril regulator maintaining proper voltage regulation.

Chief interest centers on the water-economizing devices of the water wheel. These consist of an auxiliary relief nozzle system, actuated by a Pelton self-contained oil pressure governor. The nozzles, without the governor, erected on the factory floor before shipment are shown in the second illustration. The main or power nozzle, the jet of which impinges on the wheel buckets, is at A, while the relief nozzle, the jet of which passes into the tailrace without striking the buckets, is at B, and by-passes the regulating water.

The governor, attached at C, actuates both needles, through a link system, the relative direction of movement being opposite. The main needle is directly linked to the governor system, while the relief needle is connected through the cataract compounding system shown at D. The link of the cataract is connected to a piston moving in an oil-filled cylinder. The rate of motion of this piston is controlled by compounding valves adjusted by the stems projecting at E. The cylinder is rigidly connected to the needle stems, and the coil springs at F, are compressed when the lower needle is retracted, a return of the relief needle to a complete closure being the normal function. The areas of these nozzles have a definite relation and the arms of the operating lever are so proportioned that with the compounding valves set at zero, any variation in the nozzle opening of the main or power nozzle, will be accompanied by a corresponding change, in the opposite direction, of the relief nozzle, and a constant flow is maintained through the penstock, no water economy being effected.

With the valves set for full compounding, the piston will have unimpeded motion, and the relief nozzle will not open under any load change, thus limiting the flow in the penstock to the water actually required for the load. Because of the inelasticity of the water column, this condition could only be obtained with a penstock of unusual characteristics. However, as any relative motion between the two



The Power House for the Quincy Installation

needles that may be desirable, can be obtained by proper adjustment of the compounding devices, it is easily possible to secure a relation permitting high water economy, close speed regulation, and penstock surge pressures not exceeding permissible operating limits. This unit has been in operation for several months, including the holiday peak, and the twenty-four hour water consumption has been kept at a point sufficiently low to permit of entirely satisfactory service. All talk of competition has been abandoned, and the company, with excess power at its disposal, is planning an active appliance campaign. A large vacation population makes appliances good revenue producers.

The data from which this article was prepared was obtained while making an inspection in the interests of the Pelton Water Wheel Company, contractors for the water wheel equipment. The analysis of hydraulic conditions and the general design of the plant were under the direction of Sydney Sprout, consulting engineer.

THE JOBBER: IS HE A NUISANCE OR A NECESSITY?

BY A. T. SLACK

(The electrical supply jobber is a creature of comparatively recent origin. Here is an article by an author who is connected with the Denver branch of the Western Electric Company. This article deals in a masterly manner with the real worth and scope of activity of the electrical supply jobber. It should receive the serious attention of all men interested in the electrical industry throughout the West where conditions are unusually well-adapted to increased efficiency of electrical supply brought about by the advent of the modern, electrical jobber. The paper was delivered before the recent convention of the New Mexico Electrical Association.—The Editor.)

In presenting to your association the question, "Is the Electrical Supply Jobber a Nuisance?" I did so not for the purpose of attempting to be frivolous or humorous, but to draw your attention to the fact there can be no middle ground, and unless the jobber can justify his existence as a necessity to the business, he is nothing more nor less than a nuisance and should be abolished.

The visiting salesman and advertising matter inflicted upon the central station man and our other customers are clearly a nuisance unless they prove themselves of value to him, and if they, as the representatives of the various jobbing interests, are of value, then it must necessarily follow that the jobber and his business are also of value, and he has a legitimate and necessary place in the great business in which we are all so highly interested.

Going back for a moment to the earlier days, I recall very distinctly the condition of the business at that time when this question might have been a proper one, and subject to fair and serious argument. Then the business as a whole was so small that the jobber could not justify his existence by the value which he rendered to the balance of the trade. At that time the company I have the honor to represent embraced within its business the four great divisions we find today, namely: the manufacturers, the jobber, the contractor and the central station.

It may interest you to know that the Western Electric Company was one of the pioneers in the central station business in Chicago, and their central station plants were finally sold to what is now the Commonwealth Edison Company. The rate at that time was fifty cents for each arc light per night, with the lights burning from dusk to midnight. Comparing these rates and character of service with what you gentlemen are prepared to furnish the public today through the Type "C" or nitrogen lamp, we can look back along the pathway of progress and see clearly and distinctly the advancement made in the central station business.

The manufacturers can present an equally, if not an even more brilliant pathway leading back to that humble beginning; the electrical contractor has kept step to the music, and though possibly some of you may doubt it, let me assure you the jobber has also grown and kept pace with his comrades in the line until he has proven he is not a nuisance, but an absolute necessity to you in your end of the business, just as much so as the manufacturer who builds the machinery by which you operate your plant.

First of all, let me explain to you definitely what I mean by a jobber. The electrical supply jobber is entitled to this name and to this distinction only when through the means of an up-to-date catalog and traveling salesman he can bring to you and to your place of business, at the least possible cost and expense to you, any or all of the various kinds of apparatus and supplies necessary for the building and the operation of your plant. His business is to secure from the various manufacturers all of these different kinds of apparatus and supplies, accumulate them in storerooms as conveniently located to your plant as business conditions will permit and be prepared to furnish you whatever you may choose from this vast accumulation, so that your requirements may be served promptly with no more trouble than it takes to turn to a page in a catalog and properly describe what you want.

For this service of accumulating and distributing the supplies you require, he is entitled to compensation in the nature of a reasonable profit on the goods he sells. This profit should be sufficient to meet his expenses and give him a return on the money he has invested in the business commensurate with the risk he must necessarily assume in conducting that business; and let me assure you gentlemen, his revenue and his expense cannot be foretold from month to month quite as readily as the revenue and the expenses of a public service property, with which you are more familiar.

He has confronting him the question of seasons for such supplies as fan motors, heating appliances, etc.; building conditions upon which so much depends for his contractors trade, sleet storms, cyclones and other disturbing elements of nature which play havoc with the lines, and oftentimes his men are called out at all hours to get the necessary material to you by first train so that your service may be restored in the shortest possible time.

There is attached to the jobbing business, as I have intimated, the element which you can understand best as "readiness to serve," exactly the same as in the central station business, but unfortunately we haven't found a way to satisfactorily present to our customers a minimum charge each month for this service which would meet with their approval and which we would be able to collect; nevertheless I believe the jobber, by keeping himself in a position to assist you in the immediate restoration of your service in case of disaster, is of value to you exactly as insurance has its value, although you may never have the misfortune of a fire, nor the opportunity to recover through a loss any of the premiums you may have paid.

Coming down more specifically to the direct question, "Is the Electrical Supply Jobber a Necessity?" the answer must be emphatically, yes.

Take the company I represent if you will, as a representative supply house; we had on January first, this year, in stock available for the trade, a little over eighty-seven hundred different kinds of apparatus and supplies likely to be called for, and which we consider

necessary to carry. The one line of wiring devices manufactured by the Bryant-Perkins Company alone, consists of about four hundred and fifty different kinds of articles; the additional lines are procured from about one hundred and forty different manufacturers.

Now, assuming, if you will, that we and all of the other jobbers should decide to abandon our business, would it not mean that instead of looking to one source of supply for these eighty-seven hundred various articles, you would, without question, have to deal with each of these one hundred and forty various manufacturers? Does it not mean that instead of depending upon over-night service you would have to adjust yourself to over-week service, or over-month service and increase your stock and investment accordingly? Does it not mean also, instead of dealing with the salesman representing the supply house, and from what I am led to believe they are numerous enough, you might be afflicted with an army of salesmen, each trying to make you believe the particular line he represents was the only one to buy? These are not exaggerated conditions likely to occur, but would certainly arise.

Neither do I believe the day is here when the electrical supply business can be handled as a mail order business; its progress is too rapid and its elements too technical to depend upon correspondence for success. Every successful contractor and every successful central station man wants to be abreast of the times, and I submit this can be done with the most certainty and most economically by personal contact between the buyer and the seller. Your association and this very meeting is the best evidence of your belief in this matter of personality.

As I stated in the beginning, an electrical supply jobber to be entitled to this name and position in the business must publish a catalog. That these catalogs are of value to you is best demonstrated by the fact that you will find them on the desk of every purchaser in the business, not because they are ornamental but because they are valuable. Instead of a few condensed, well compiled catalogs, assume it was necessary for you to have a separate catalog of each of the one hundred and forty manufacturers to whom I have referred when you wished information; and it should be remembered also, that as a rule the jobber sells a line of but one manufacturer, and as each line has, I am sure, an average of, at least, five different manufacturers, instead of one hundred and forty catalogs you would be more likely to have some five or six hundred to consult or destroy, as your office space permitted—would such a condition make you long for a jobber's catalog with which you are familiar? I believe it would.

These few but unmistakable ways I have attempted to bring to your attention, are not the only ways in which the jobber has justified his position in the business; he is doing his share in the field of cooperative work, and in the great work planned by the Society for Electrical Development; he has assumed his share of the burden and his share of the work to make good the slogan "Do It Electrically," and a word or two regarding its work may not be amiss.

A few years ago some of the biggest men and brightest minds in the business conceived the idea that, first of all, the four great divisions of the business had their respective fields with distinct and natural boundaries and limitations:

First comes the manufacturer, whose aim it is to develop and manufacture the apparatus and supplies required in the business.

Second comes the jobber who, as I have attempted to point out, accumulates all of these various kinds of apparatus and supplies from the various places at which they are manufactured and concentrates them in a place convenient to their ultimate use.

Third follows the contractor, whose job it is to take the apparatus and supplies as delivered to him by the jobber, and place them in their permanent position ready for the current furnished by you gentlemen.

And finally comes the central station with their job practically limited to making the connection and collecting their revenue.

You may also have overlooked the interesting fact that the first three men receive only one profit on their sales, and a most moderate one at that, while the revenue or profit of the central station man continues on forever or, as long as he operates his plant.

As I have said, the men who conceived this Society for Electrical Development saw these respective fields distinctly, and more than that, they saw the tremendous amount of money spent each year in advertising to secure the business that had already been created by wresting it from each other, and they realized and believed that if a part of this vast sum was used to create a new demand, thus creating new and additional business for the manufacturer; that not only he, but the jobber, contractor and central station man as well, would all profit by the new demand, and they believed also this new demand could best be created through the joint efforts and the joint resources of the entire industry. The result was, as you know, the larger interests pledged their support and have endeavored to have others do likewise.

The sum of two hundred thousand ($200,000) dollars per annum has been pledged, and the society has just started on their campaign to instill into the minds of the public that the way to do things is to "Do It Electrically," and some of the tangible results are already beginning to reach the members.

Perhaps you have noticed, that a great many contractors' windows, and this applies, to a large extent, to the central station display windows as well, look more like a work bench than an effort to induce people to buy goods; the society is studying out the best methods to display the goods offered for sale. This however does not apply to the central station and contractors in Albuquerque.

Instead of being the best lighted and most tastefully decorated windows in town, I have found electric shops which came closer to being the worst. If the contractor, or central station man, is indifferent to his window lighting and display, how can he expect his neighbors to take any interest and furnish him any business?

Not only the Society for Electrical Development, but all the first-class jobbers and manufacturers through the jobbers, recognize this deficiency and are furnishing for display purposes all kinds of attractive

advertising matter and instructions how to display it, absolutely free of cost to those requiring it.

I would also like to call your attention to the fact that the most advanced jobbers today are spending their efforts, not so much to sell the goods to the central station, contractor and dealer, but rather to help and educate him to see that the goods are sold to the ultimate consumer.

This society is endeavoring to have the settings of moving pictures brought up to date by showing the use of electrical apparatus and household appliances; in one instance where a picture showed an accident due to the use of electrical current, they have had this part of the film changed.

The company which I represent has for the past year furnished a 1000 ft. film called "Drudge," leading up from the old household drudgery to the present modern electrical appliances of today which we are glad to supply to the central station men at any time wanted.

The advertising campaign of the National Electric Lamp Association with which you are more or less familiar, is a fine example of what co-operative advertising and creative sales work can accomplish at a minimum expense to all.

I could go on at length showing what is being done and contemplated, but I shall have to leave this to the printed reports sent to each member monthly, and if you have not received a copy let us know and we will see you are supplied.

While, as I have said, I have endeavored to show that there is a well recognized line between the service the manufacturer and jobber render to the electrical industry as a whole, I realize that sometimes you are confronted with the opportunity to buy your supplies direct from the manufacturer, or through a jobber, at exactly the same price; the question then is, which one should be favored with the business, and different men look upon the proper answer from different points of view.

Laying aside entirely the question of personality, it is clear that the business should go to the one from whom the purchaser will secure the most value for his money; prices and articles being the same, it is equally clear this additional value must come through some indirect return, usually service.

I hope you will all agree with me that the concession the jobber secures from the manufacturer in the more favorable price, due to the greater opportunity he has for disposing of the goods, and which enables him to sell to the consumer on an equal basis, is a legitimate concession and one he is justly entitled to, because it simply follows one of the fundamental rules of business that, the greater the purchasing power the more favorable prices it commands.

Some purchasers, but I am glad to say they are in the minority, have taken the position that, by favoring the manufacturer direct on an even price basis they are advancing their own interests. As near as I can ascertain, their theory is, that by doing so they are more likely to secure the same price as the jobber on their next purchase. I sincerely believe however, this is a mistaken idea, and that just as long as the jobber holds the greater buying power just that long the manufacturer will find it to his interest to sell him at a more favorable price.

It seems clear to me however, there can be no question as to what attitude you should take when these conditions confront you; the jobber is entitled to your business on an even break for the service he is in position to render you, and you are serving your own interest best by seeing that he gets it.

There is another element of relationship with the jobber that should not be overlooked. The fundamental basis of his relation with you is service, but it is accompanied by that other important element of quality. You will find invariably the better class of jobbers do business on the basis of quality and service first; that is, they determine the cost of their merchandise and add to that, the cost of satisfactory service to you and a reasonable profit to themselves, and then fix their selling price to you accordingly. Thus, as I have said, let the cost of their merchandise and doing business control their prices. On the other hand, you have people attempting to sell you goods in competition with the jobbers, whose business is based on price first and the quality of goods and the service rendered is controlled absolutely by what they can afford to give for the price they have been able to obtain.

The question of which of such policies it is to your advantage to accept, could be answered readily and to a certainty if the price you paid the supplier was the cost to you of the goods that have been purchased, but unfortunately the cost of merchandise does not cease when the bill is paid to the supplier. This distinction of price and cost is one too often and too readily overlooked by the average buyer. The price is always certain and readily ascertained, it is limited invariably to the amount of cash you pay for the purchase and nothing more, but this by no means is the cost of the goods. If the purchase is made for resale the cost cannot be ascertained until the goods have been sold and the money collected, and even at this period you are not entirely safe in assuming that the additional costs added to the price have all been taken care of, as no doubt the goods you sell carry with them a guaranty, either expressed or implied, and the cost of making good on these guarantees must be added to the price paid the supplier.

This same element, but to a much greater extent, exists in the purchases made for use and operation. In such cases, to the original price paid must be added the cost of maintenance, and comparative costs of operation and the comparative life of the particular article or piece of apparatus in question; and here again, you cannot determine your definite cost until final disposition is made to the junk dealer, or until it is otherwise disposed of.

The careful, far-sighted purchaser never fails to keep before him this distinction between price and cost, and, as I have said, the best supply jobbers sell only that class of merchandise and render such service, that the difference between the price they charge and the ultimate cost to the purchaser is narrowed down to the smallest possible margin.

Now gentlemen, I hope I have shown you good cause to believe the electrical supply jobber is not a nuisance but a necessity, and as a necessity I am

going to appeal to you to see that this necessity is recognized and appreciated in the broadest possible way.

The business of the jobber in accumulating and distributing the products you require is a comprehensive and an expensive business to conduct and he is entitled to a fair return for his services.

Mr. Franklin Overbaugh, general secretary of the Electrical Supply Jobbers' Association, advises me that as far as he can ascertain, the records show the average bill of the jobber is about twenty ($20.00) dollars for each shipment. What his net profit is I will not attempt to say, as this depends entirely upon his efficiency as a business man; but I believe you will have to think hard and long to recall any man engaged in the jobbing business who has accumulated a sufficient fortune to enable him to retire and live off the interest on his money.

As I have attempted to point out, the jobbers have endeavored to do their part to have this country occupy the proud position it holds today as the foremost in the world, not only in its great electrical industries, but in the wide-spread use of electricity as well.

I hope I have convinced you gentlemen that the electrical supply jobber is not only a necessity but also, that his success means your success, and that you should continue to give him, not only encouragement, but your unlimited support, so that he can make himself even more valuable to you than he has in the past.

It is a known fact that some of the largest manufacturers in the country today are refusing to ship or build direct to the trade, preferring that their business be handled through the jobber. That I think in itself conclusively shows that the electrical jobber is absolutely a necessity.

THE DISASTER AT THE MOUNTAIN KING MINE

A recent disaster happened at the Mountain King Mine on the Merced River in California. The mine derives its power from its own hydroelectric plant, diverting the flow from the Merced River through about a mile of flume. At a point close to the power house there was a leak started in the flume due to the checking in the seasoning of stringer timbers. This was not serious but in order not to interfere with the operation of the plant a temporary repair had been made until such time as the plant could be shut down for a few hours to make the repair permanent.

On the morning of the day of the accident the point in the flume under repair began to give trouble and the plant was shut down and the water turned out so that the slopping over would not wash away the hillside below the flume. This caused the air-compressor at the mine to shut down before the smoke and gas in the winze could be blown out.

It is alleged that notice was served upon men not to enter the workings during the period of shut down. Certain of the men entered, however, and were as a consequence overcome by the gas. The hydroelectric plant meanwhile was put back again into service during the day of the accident after the three or four troublesome sections of fluming were repaired.

LETTER TO THE EDITOR ON THE NATIONAL CRISIS

Sir:

In this great time, when every citizen must do his part, the President has made his chief appeal to the men who live on the land. He is right in doing so, for the safety of our country just now is in the hands of our farmers. What I mean is not merely our safety and the safety of our allies in the matter of food. I mean that the safety of the United States against foreign invasion hangs on the decision of the farmers of the forty-eight states.

The two great weapons in this war are arms and starvation. The war against German arms will be won or lost in France—the war against starvation will be won or lost in America. The Kaiser cannot whip the French and English armies and the English navy while England has food. But it is still possible that the German submarines may be able to keep food enough from reaching England to starve her into submission.

If the submarines win, the first item in the Kaiser's terms of peace will be the English fleet. With the English fleet in his possession, the Kaiser will be master of the world.

What will happen to us then? Every man who stops to think knows the answer. We shall have money, food, labor, land,—everything that is desirable in the world except the power to protect what we have. Experts estimate that it will take us nine months to get ready to meet a German army of 150,000 men, with modern artillery. Under such circumstances, would the Germans treat us better than they already treated Belgium and France?

Even if the armies of our allies should crush the German military power this summer, before the shortage of food can reach the point of want, the world would still need vast quantities of American food. But if they do not, only one course can make us safe, and that is to grow food enough on our farms for ourselves and our allies, and to put ships enough on the sea to carry the food, in spite of the submarines, to the men who are fighting our fight.

If the war lasts beyond this summer, it will be the American farmer who will win or lose the war, who will overcome militarism and autocracy, or allow them to spread and control the world, ourselves included.

This is no fanciful picture, but sober fact. Many a man will make light of it until he comes to think it over, but I venture to say that few will treat it lightly after careful thought. It is no more impossible than the great war itself appeared to be, only a few days before it began.

It is true that we can greatly increase the available food supply out of grain now used in making liquors, and by reducing household waste. But when these two things are done, and done thoroughly, they will not be enough. The final decision will still rest in the hands of the men who raise our food in the first place.

The clear duty of the Nation is to guarantee the farmers a fair price for their crops when grown, and a reasonable supply of labor at harvest. The clear duty of the farmer is to raise food enough to win this war for democracy against Kaiserism.

No such responsibility has ever rested on any class of men since the world began as rests today on the farmers of America.

Sincerely yours,

GIFFORD PINCHOT.

On parts of the Angeles National Forest in California the packrats are so abundant that many of the young pines planted by the Forest Service have been killed or injured by the rodents. The damage seems to take place chiefly in the late summer and fall and is more extensive in dry than in wet seasons. It is thought that the rats tear off the tender bark of the trees to obtain moisture at times when water is scarce.

HYPERBOLIC SOLUTION FOR ENGINEERING PROBLEMS

BY W. D. PEASLEE

(Transmission line phenomena are intricately associated with hyperbolic functions when any mathematical representation or analysis is attempted by the engineer. Here is a discussion that should enable engineers not previously familiar with the subject to obtain a workable use of this valuable form of analysis, and, again, it is believed that a thorough mastication of the discussion set forth will arouse some to further study of the subject. The author is in the department of electrical engineering at the Oregon Agricultural College, and is a well-known consulting engineer of Portland, Oregon.—The Editor.)

In the investigation of engineering problems mathematics of one degree or another is the universal means of correlating the given conditions of a case into terms of effect or in other words into operation, and a great many engineers solve problems by very laborious methods through their ignorance of the existence of a better easier method. Higher mathematics are in general merely short cuts and the higher the mathematics the shorter the cut, and as such they should be the tool of engineers to a much greater extent than they are today.

This article is not intended in any way as a complete exposition of the subject nor as an original discussion as all the formulae used have been developed by many other workers and may be found completely in the brief bibliography at the end. Some of the problems have been taken in part from various texts and the charts used have been developed by at least Fleming and Kennelly. It is however unfortunately true that these charts as well as the methods of use of Hyperbolic Functions are unknown to many engineers and this fact is the only excuse offered for their presentation.

It is hoped that two results may be realized by the presentation of this article; first that it may give to engineers not previously familiar with the subject, a workable use of certain of its most valuable equations and second, that it may arouse some to a further study of the subject, and to that end a brief bibliography is appended.

First the application of Hyperbolic Functions to the solution of a transmission line problem will be taken up and later brief mention will be made of some other branches of engineering work wherein they may be used to great advantage.

Anyone who has attempted an extended investigation of the variation of the voltage and current in a transmission line in terms of distance from the receiving or sending end will realize the vast amount of actual mathematical manipulation involved and to

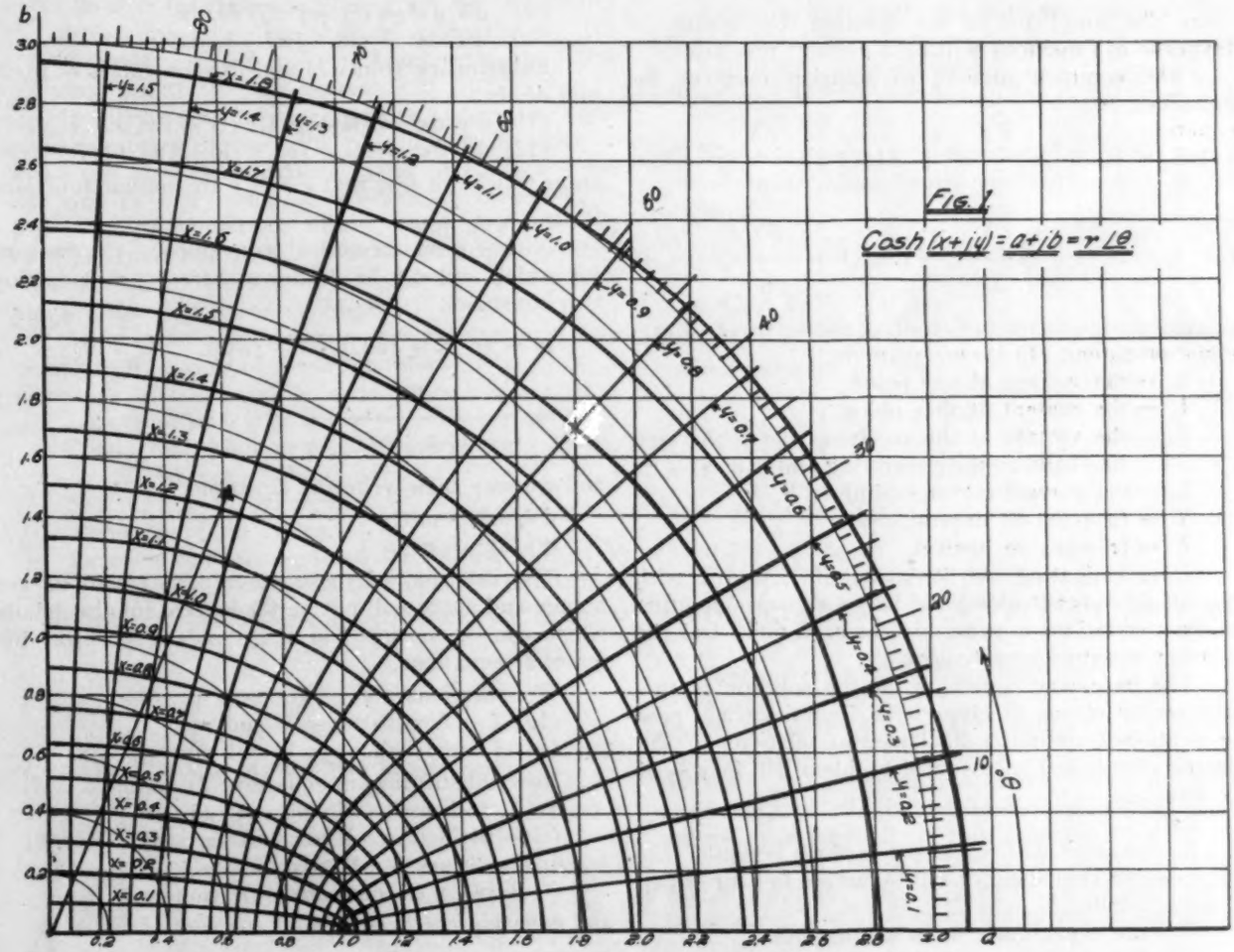


Fig. 1. A Graphic Chart of the Hyperbolic Cosine

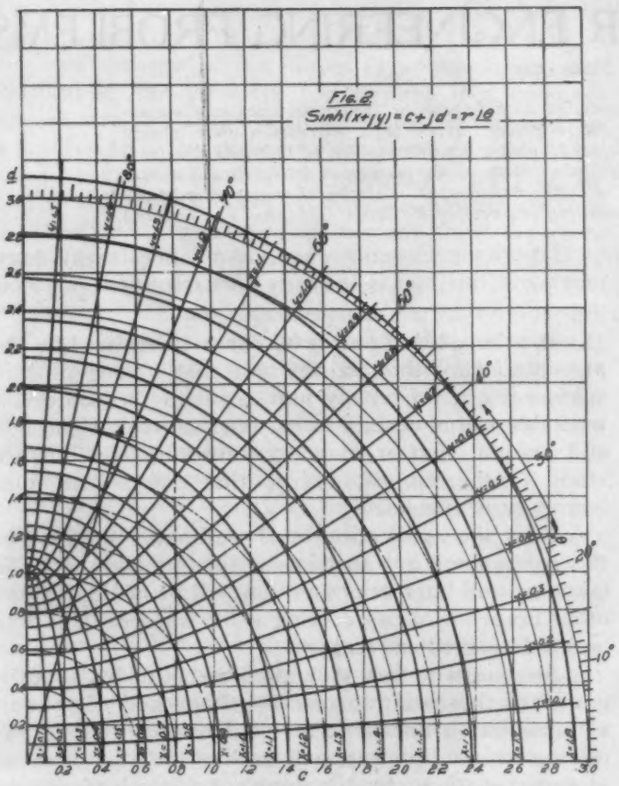


Fig. 2. A Graphic Chart of the Hyperbolic Sine

them the simplicity of the solution by means of Hyperbolic Functions will be a distinct revelation.

The common method of solution involves the equations,

$$(1)\quad E_1 = E_0\left(1+\frac{ZY}{2}\right) + ZI_0\left(1+\frac{ZY}{6}\right) + \text{- - -}$$

$$(2)\quad I_1 = I_0\left(1+\frac{ZY}{2}\right) + YE_0\left(1+\frac{ZY}{6}\right) + \text{- - -}$$

using only the terms indicated as the series is so rapidly convergent. In these equations,

E_1 = the voltage at any point.
I_1 = the current at that point.
E_0 = the voltage at the receiving end if the sign is + and at the generating end if it is —.
I_0 = the current corresponding to E_0.
$Y = (g + jb)$ to neutral.
$Z = (r + jx)$ to neutral.

If investigating the variation of E and I with respect to distance along the line a separate solution of these equations is necessary for each point and the solution becomes very tedious.

The necessary equations for the solution of this problem by means of Hyperbolic Functions will now be developed from the fundamental relations of the electric circuit and an assumed problem will be solved by their aid.

Let,
R = resistance of conductor in ohms per mile.
L = the coefficient of self induction in henries per mile.
C = the capacitance in farads per mile.
G = the coefficient of leakage in ohms per mile.

It may be shown[1], that if any simple harmonic function asin $(wt + \theta)$ be represented by a vector of length a and angle θ then two simple harmonics of the same period $2\pi/w$ but having different values of phase angle θ can be combined by adding their representative vectors.

The voltage and current at any point of a circuit distant x from the receiving end are expressed by the equations,

$$(3)\quad e = e_0 \sin(wt + \theta)$$
$$(4)\quad i = i_0 \sin(wt + \theta')$$

wherein e, i, θ, and θ' are all functions of x.

The relations between e and i are expressed[2] by the equations,

[2]Loc. Cit. p. 181.

$$(5)\quad di/dx = Ge + C\, de/dt.$$
$$(6)\quad de/dx = Ri + L\, di/dt.$$

Now $de/dt = we_1 \cos(wt + \theta) = we_1 \sin(wt + \theta + \pi/2)$ so de/dt will be represented by the vector $we_1/\theta + \pi/2$ and di/dx will be represented by the sum of vectors Ge_1/θ and $Cwe_1/\theta + \pi/2$, whose numerical magnitudes are Ge and $jwC\bar{e}$. By similar reasoning for de/dx in equation (6) we have,

$$(7)\quad d\bar{\imath}/dx = (G + jwC)\,\bar{e}.$$
$$(8)\quad d\bar{\imath}/dx = (R + jwL)\,\bar{\imath}.$$

which are equations that do not involve time derivatives.

Differentiating these equations with respect to x we have,

$$(9)\quad d^2\bar{\imath}/dx^2 = (G + jwC)\, d\bar{e}/dx.$$
$$(10)\quad d^2\bar{e}/dx^2 = (R + jwL)\, d\bar{\imath}/dx.$$

Substituting from (7) and (8) the values of $d\bar{\imath}/dx$ and $d\bar{e}/dx$

$$(11)\quad d^2\bar{e}/dx^2 = (R + jwL)(G + jwC)\,\bar{e}.$$
$$(12)\quad d^2\bar{\imath}/dx^2 = (G + jwC)(R + jwL)\,\bar{\imath}.$$

from which we find that $\bar{e}$ and $\bar{\imath}$ are similar functions of x.

Now for mathematical convenience the reasons for which will not be discussed here we will employ two constants,

$$m = \sqrt{(R + jwL)(G + jwC)}.$$

$$m_1 = \frac{m}{G + jwC}$$

and we may then write the equations

$$d^2\bar{e}/dx^2 = m^2\bar{e}.$$
$$d^2\bar{\imath}/dx^2 = m^2\bar{\imath}.$$

The solutions of these differential equations are simple and space will not be taken here for the details which can be consulted in any standard work on differential equations.

The solutions are,

$$(13)\quad \bar{e} = A\cosh mx + B\sinh mx.$$
$$(14)\quad \bar{\imath} = A'\cosh mx + B'\sinh mx.$$

Now substituting in equation (7) we have

$d(A'\cosh mx + B'\sinh mx)/dx =$
$(G + jwC)(A\cosh mx + B\sinh mx)$,
$mA'\sinh mx + mB'\cosh mx =$
$(G + jwC)(A\cosh mx + B\sinh mx)$.

and equating coefficients,

[1]Bedell and Crehore, Alternating Currents, page 214.

$mA' = (G + jwC)\ B$ and $mB' = (G + jwC)\ A$ from which $A' = B/m_1$ and $B' = A/m_1$, so we find that only two of the constants in (13) and (14) are arbitrary.

Now establishing the following conventions,

E = receiver voltage.

I = receiver current.

e_x = voltage at any point distant x from receiver.

i_x = current at any point distant x from receiver.

and putting x = O we have

E = A.

I = A' from which we have

B = m_1I.

B' = E/m_1, and equations (13) and (14) then become,

(15) $e_x = E \cosh mx + m_1 I \sinh mx$.

(16) $i_x = I \cosh mx + E/m_1 \sinh mx$.

It can be easily shown that if we consider E and I as the voltage and current at the generator end and measure x from that end these equations become

(17) $e_x = E \cosh mx - m_1 I \sinh mx$.

(18) $i_x = I \cosh mx - E/m_1 \sinh mx$.

Equations (15) and (16) are very interesting as they express the current and voltage of the line in the no load and load components as will be seen if we let I = O we have as the charging current $i_c = E/m_1 \sinh mx$.

The load current then is represented by the expression, $i_L = I \cosh mx$.

Likewise for the voltage equation we find that,

$E \cosh mx$ = the line voltage influenced by the charging current and, $m_1 I \sinh mx$ = the line drop due to the load current.

It will be seen however that m and m_1 are complex quantities of the form a + jb and in order to make use of these equations tables of cosh (x + jy) and sinh (x + jy) must be available, or these quantities must be computed, which would make the use of these functions as laborious as any other method of computation. Several very good tables are available and are listed in the bibliography.

An assumed transmission line problem will now be solved by means of these equations.

Given:

Length of line: 500 miles.

Conductor: Aluminum cable, steel core, 1.25" dia. 800,000 cm. of aluminum.

Spacing: 30 ft., triangular.

Three phase, 60 cycles.

Receiver conditions: Load 150,000 kw., 85% P.F. lagging. Voltage 250,000 (144,000 to neutral)

Problem: Find the voltage and current relations for all parts of the line under full and no load operation.

r = 0.1127 ohms per mile.

$$C = \frac{89.4 \times 10^{-9}}{\text{Cosh}^{-1} D/d} = 14.08 \times 10^{-9} \text{ farads per mile.}$$

$jwC = j2\pi 60C = 5.31 \times 10^{-6}$.

$jwL = jx = j2\pi 60L = j2\pi 60 \times 5.28\ (1.41 \log_{10} D/d + .576)\ 10^{-4}$.

jwl = j.803 ohms per mile.

r + jx = .1127 + j.803.

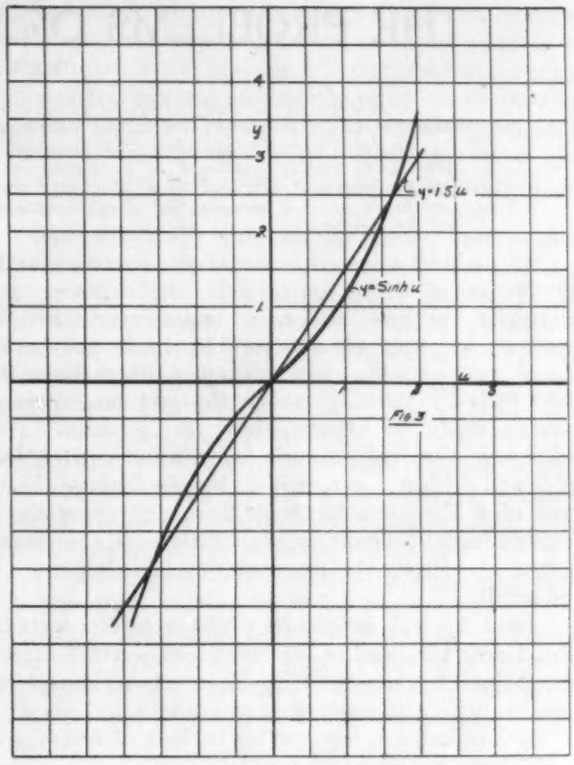


Fig. 3. Method of Solution by Intersections

Assuming 300 watts per mile per conductor leakage and corona loss we have

$g = 1.48 \times 10^{-7}$ ohms per mile.

$g + jwC = 1.48 \times 10^{-7} + j5.31 \times 10^{-6} = 10^{-6}\ (.148 + j5.31)$
$= 5.315\ \angle 74° 43' \times 10^{-6}$.

These values are all computed for one wire to neutral in accordance with standard practice in such problems.

$m^2 = (r + jx)\ (g + jwC) = (.1127 + j.803)\ (.145 + j5.31)\ 10^{-6}$
$= 4.3 \times 10^{-6} \angle 171° 28'$.

$m = 2.075 \times 10^{-3}\ \angle 85° 44' = .000154 + j.002065$ an abstract coefficient per mile of this line.

$$m_1 = m/(g + jwC) = \frac{2.075 \times 10^{-3}}{5.315 \times 10^{-6}}\ \frac{\angle 85° 44'}{\angle 74° 43'}$$

$= .391 \times 10^3\ \angle 11° 1'$.

$= 383 + j74.6$.

HYDROELECTRIC ACTIVITY IN NEW ZEALAND

The government hydroelectric plant at Lake Coleridge, about 70 miles west of Christchurch, was opened during the year with splendid results for Christchurch and vicinity. The city is now lighted by electricity, the tramcars are operated with power from this source, and many of the industries in and about the city secure their power from this plant, at very low rates in all cases. There is a demand for more current than can be supplied by the present installation of 6000 horsepower, and it is proposed to put in another unit of equal power.

THE PROBLEMS OF WATER REQUIREMENTS

BY FRED F. HENSHAW

(Accuracy in the study of discharge records for power development is of far greater importance than for uses in irrigation. In both of these studies, however, the minimum flow for a cycle of years must be carefully investigated. Previous discussions by the author, who is district engineer of the U. S. Geological Survey, stationed at Portland, Ore., have dealt with the mass curve and with the use of probability paper for analysis of discharge records. In this article the problems of water requirements are taken up in a manner that should prove usefu and helpful to engineers throughout the West. —The Editor.)

In making a water-power study, to arrive at the horsepower available or feasible, the engineer must determine the head and must make certain assumptions as to plant efficiency. The head can be obtained very closely. The efficiency of turbines has been raised materially within the last few years by careful study of design, but the probable gross efficiency of a hydroelectric installation can be foretold well within 5 per cent in the designing. In the case of a dam development there are generally no seepage losses. Those by evaporation are almost negligible. In short, the uncertainties in using the data are small.

In a typical irrigation project, where water is stored near the head of the river and diverted at, say, two points farther down, there must be considered, besides the actual water supply available,

1. Evaporation from water surface of reservoir.
2. Seepage losses in canals.
3. The duty of water, or the amount required for a proper irrigation.
4. The amount of return water that will be available at the lower diversion.

(1) Our information on depth of evaporation to be expected in a reservoir at varying elevations and different conditions of humidity, of climate, exposure to wind, etc., is not at all complete, and the data available are often inconsistent. I believe that an engineer can not be sure of his evaporation loss within 20 per cent, and such loss may be from 5 to 15 per cent of the total water supply.

(2) Seepage losses in canals are small in concrete-lined or other high-grade, well-designed structures, but ordinarily they are large, and often conditions will not warrant large expenditures to reduce them. The estimated loss for any given type of construction over a certain assumed canal line will generally be subject to an error of 25 to 50 per cent, and may amount to 10 to 40 per cent of the total supply available.

(3) The duty of water is a subject on which data are being accumulated rapidly, and the information becomes more valuable as more projects are put on a conservative basis of management. The quantity of water served to land under old projects is generally large, very often wastefully large, and hardly affords a criterion for assumptions as to the proper duty for a proposed project. Certainly a probable error of 15 or 20 per cent must be allowed on the duty of water, and this applies on the whole available water supply.

(4) The return water from a large irrigated tract must be studied when diverting below the point of seepage return, as considerable of this water can be recovered. As to the probable amount of such return under future conditions of complete development there appears to be greater uncertainty than in the case of evaporation, seepage, or duty. But it will almost always be found that the greater the canal losses and the larger the quantities of water applied, the greater will be the quantity of return water available for another project below. Thus the uncertainties of (4) tend to compensate those of (2) and (3).

Taken as a whole, the uncertainties in an estimate of the quantity of water required for a given area of land, made before the development of the project, will generally be at least 20 or 25 per cent.

In considering a problem of municipal water supply the uncertainties are similar to the first and third noted above. The error in estimating evaporation on a reservoir may represent a small percentage of total quantity of water required. The question of quantity of water required at any future time involves an estimate of the rate of growth of the municipality to be served and the per capita consumption.

In the control of floods, relief may be sought by dikes, dredging or channel alignment, to lower flood planes or to confine the torrents and keep the water away from the property. The hydraulic laws governing flow of water in flood channels are imperfectly known, and their application is difficult. Where it is proposed to reduce flood heights by storing water in reservoirs the process of estimating reduction in stage for any given reduction in discharge is relatively simple. Some of the big uncertainties in such a case are the length of time required for water to pass downstream from any given reservoir and the overlapping and flattening out of flood peaks.

Application of Discharge Data to Specific Problems.—One specific problem to which the graphic method of analysis just outlined may be applied is the determination of the continuous power at a given site. It is stated by Mr. L. F. Harza[1] in his report on the Columbia River power project:

> **"The usual minimum flow of a river is a more significant quantity in planning a power development than the absolute minimum. The latter in fact can never be determined, and nearly all hydroelectric developments are subject to occasional deficiencies at times of extreme minimum. This is not necessarily an accident when it occurs, but is usually foreseen and planned for. An occasional sacrifice for a few days or even weeks once in several years is preferable from an economic standpoint to the failure to use the power during the major portion of the time when it is available. The extent of the application of this principle necessarily depends upon the char- of natural resources to an intolerable degree."**

He selected as the usual minimum for Columbia River a discharge of 50,000 second-feet. From the

[1]Harza, L. F., Columbia River power project near The Dalle, Oregon; U. S. Recl. Service in coop. with State of Oreg., Report of Board of Review, p. 9, 1914.

probability curve for the minimum flow at The Dalles, it is noted that the value selected lies on the 92 per cent line; that is, the flow would be expected to be below this only 8 years out of 100. For the North Umpqua, with its low coefficient of probable variation, probably 800 second-feet would be taken as a safe minimum. The absolute minimum would be lower than this one year in four, but it would be 10 per cent lower only one year in ten.

To determine the economic development of a given site, secondary as well as primary power must be considered. Mr. Clemens Herschel,[1] in a report on the utilization of the Great Falls of the Potomac River, states:

> "To use only 1000 second-feet (practically the minimum flow) for power out of Potomac River would be, to use a homely simile, as though we were using only the tenderloin out of a beef carcass and rendering unfit for any use, present or future, all the rest of the food available. That is to say, it would be extremely wasteful and permanently destructive of one of the natural resources of the country; going against the fundamental principles of all that is good in the modern doctrine of the conservation of natural resources to an intolerabel degree."

The study of the second-class power available necessitates the use of the curves of duration of flow. The criterion of development of second-class power depends on local market conditions. In parts of the East, power available half the time in an average year might be used, whereas in other parts of the country the power might have to be available for nine months continuously in a low year.

The application of the mass curve method to the study of irrigation with available storage has already been discussed for the Deschutes where the problem was relatively simple. There was only one reservoir, and the diversion point was practically at the storage site.

If the diversion is made below the reservoir, and a considerable quantity of water enters between, the mass curve is drawn for the reservoir as in the case of the Deschutes. The quantity stored is the total flow at the dam site during the non-irrigation season and whatever surplus there is at the point of diversion during the irrigation season. The draft from the reservoir is determined by the deficiency in supply at the point of diversion, and may occur during only half the irrigation season in some cases. The records of discharge at the diversion point are used in such a study only when the inflow below the reservoir can not supply the demand, which period may be all or only a part of the irrigation season. The records at the dam are used only when there is water available to store, and as far as such a study goes might be dispensed with for other periods.

Conclusions.—The determination of the discharge of streams of relatively uniform flow and steady regimen will usually justify a much higher degree of accuracy than is required in the case of more variable streams. Streams having a wide range from year to year in their low-water or average flow must be measured for a relatively long period of years, whereas on a stream of more uniform characteristics a shorter period of records may suffice. In other words, it would not seem advisable to seek the ultimate refinements of accuracy in studying a widely varying stream, but rather to give first consideration to prolonging the period covered by records.

Records chiefly valuable for power studies must in general be more accurate than those which will be used mostly for consideration of irrigation; 10 per cent accuracy in many cases is probably all that our knowledge of use of water for irrigation justifies. On the other hand we should endeavor to get our power records well within 5 per cent.

It is highly important in the case of irrigation streams that records cover the year or cycle of minimum run-off, as the justifiable use bears a far closer relation to the permissible deficiency at such times than it does to the average run-off of the stream.

It is not absolutely essential to keep up records at a proposed point of diversion for irrigation during the winter; neither is it necessary that a station valuable only for storage be kept up during parts of the summer. Such a suspension of records might not be advisable, but it is often worth considering.

[1]Water supply of the District of Columbia and water power at Great Falls: 62d Cong., 3d sess., House Doc. no. 1400, Washington, 1913, p. 48.

OUR PREPAREDNESS FOR FOREIGN TRADE

Walter F. Wyman, manager of the export department of Carter's Ink Company, has compiled some interesting notations on export trade as a profit maker for American citizens. In the following diagram he

Diagramatic Notations on American Preparedness for Foreign Trade

shows in a striking manner what six per cent of the world's population can produce upon seven per cent of the world's land area, thus showing our preparedness for foreign trade effort.

PHOTOGRAPHY FOR ENGINEERS

(The question of exposure often proves troublesome and perplexing to the engineer when gathering his data in the field by means of the camera. The author, who is with the engineering staff of the Pacific Gas & Electric Company, has developed some original ideas in the way of a curve for rapidly ascertaining this factor. The curve given herewith may be placed in the camera case and thus made readily available for future use when occasion arises for instant service with the camera as it so often does in engineering practice when one is not making a constant use of the camera.—The Editor.)

WHAT EXPOSURE SHALL I GIVE?

BY C. B. MERRICK

In the preceding article the fundamental influences which affect the photographic film were reviewed, and the next step is the placing of this data into a convenient form. The accompanying diagram (Fig. 1) includes all these various features, so

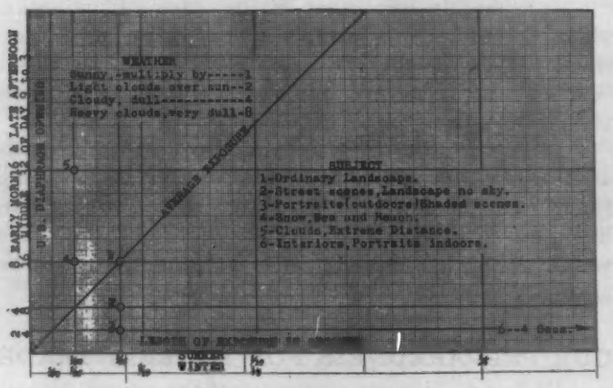


Diagram for Quickly Ascertaining Length of Exposure

that an exposure for any given set of conditions can be quickly estimated. The diaphragm openings are plotted as ordinates, and the length of the exposure as abscissae. Since the exposure for a sunny summer landscape is stop sixteen and 1/25 second, a line through the zero point and No. 1 (16 1/25) represents the average exposure. Any point on this line will give the same resultant exposure as No. 1, i.e. 8 1/50. Any point above the line will give a less exposure and any point below the line will give a greater exposure.

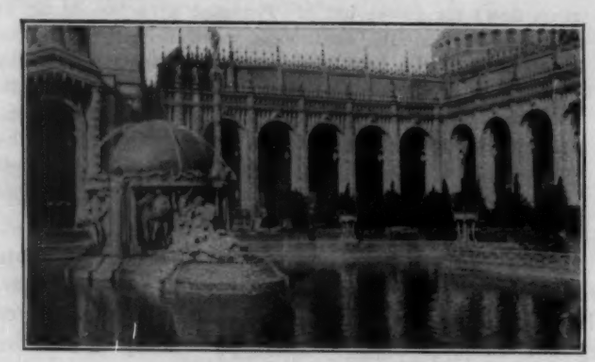
The subjects are listed in six groups and the best exposure for ordinary conditions is plotted for each group. The corresponding ordinate and abscissa give the exposure for each. Two scales are given for ordinates and two for abscissae, and the one is to be used which corresponds with the time when the picture is taken. If the weather is other than bright and sunshiny, the exposure must be increased by the appropriate factor in the weather table.

As an example, to photograph a street scene at 4 p. m. on a cloudy, dull day in January, we find point No. 2. The abscissa of No. 2 for winter is 2/25 second and the ordinate for late afternoon is stop No. 4. Since the weather is cloudy dull, this exposure of 4 2/25 must be multiplied by the factor 4. Therefore, the required exposure is No. 4 diaphram and 8/25 or 1/3 second. Open and close bulb quickly — ¼ second exposure. This requires a bulb exposure and therefore a tripod or firm support for the camera.

The diagram is made for use with the Uniform System (U.S.), but the corresponding f values of diaphragm opening are readily found from Table No. 1. The two systems have the same exposure value at

U. S. 16 — f. 16.

The speed of a lens is regulated not by the actual aperture of the diaphragm or by the focal length of the lens, but by the relation between the two. It will be seen from the diagram that by using a lens of



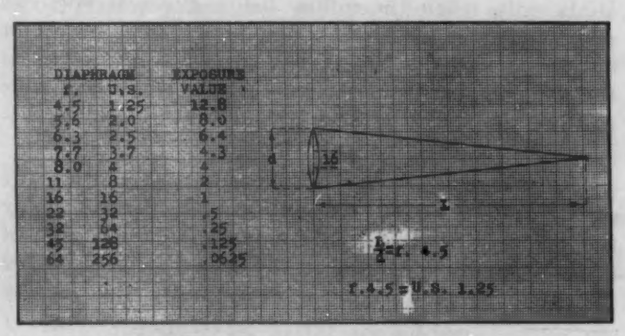
A Picture Taken at the San Francisco Exposition by Using Exposure Diagram

3 in. focal length, and ½ in. aperture we will obtain a certain unit intensity of light upon the film. If instead we use a lens of 6 in. focal length, the aperture for the same unit intensity will necessarily be 1 in. diameter. Consequently lenses are rated upon this relation, the f system being the ratio of the focal length to the diameter of the stop, the U. S. being the relation between the focal length and the area of the opening.

$$f = \frac{l}{d}$$

$$U.S. = \frac{l}{d^2}$$

From these facts it will be seen that for equal exposures the variation of the U. S. from 16 will be the square of the variation in the f system, i.e.:



Relationship of the Two Diaphragm Systems

(Concluded on page 392)

DEMAND METERS OE TIME LAG TYPE

BY W. A. HILLEBRAND

(Indicating wattmeters and ammeters with movement constrained by some device to give a suitable time lag so as to employ them as demand meters have found a useful and necessary place in the evolution of this important type of meter. In this installment of a series of three articles begun in the issue of May 1, 1917, the author who is with the engineering staff of the Pacific Gas & Electric Company, discusses the General Electric Type W, the Lincoln Meter and the Westinghouse R O Meter known as the time lag class of demand meters. The series will be concluded in the next issue of the Journal. —The Editor.)

General Electric Type W

This meter has been withdrawn from production but is referred to here because it represents an interesting development. It consists of a standard watthour meter element and disc, the latter controlled by three springs in series so that it may make three complete revolutions for full scale deflection of the pointer. Damping is secured by a battery of permanent magnets which retard the deflection of the meter disc. The characteristic curve of this meter is given in Fig. 7. Its principal disadvantage is that its time element is too short, the indication being unduly affected by temporary overloads.

Lincoln Meter

This meter is not in production but is referred to here because it is interesting as a type. The advantages claimed for it are moderate cost, great simplicity with consequent reliability and a time characteristic that makes it more suitable than other meters on the market. For a detailed description the reader is referred to Mr. Lincoln's paper.[1]

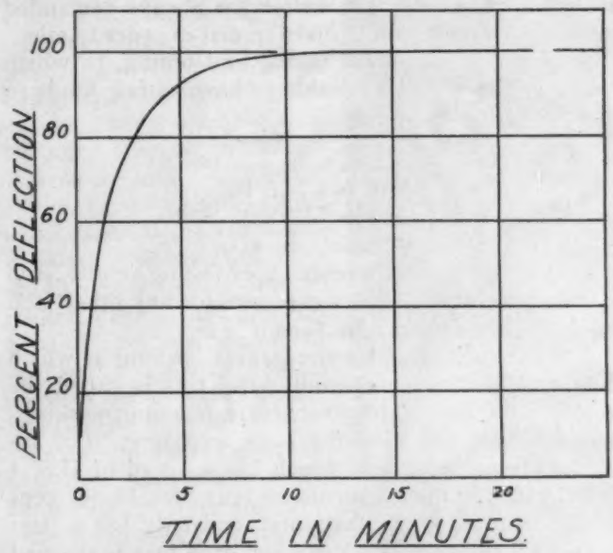


Fig. 7. Characteristic Curve of Induction Type of Demand Indicator—General Electric Design

The instrument is a thermal wattmeter with a time lag produced by the thermal capacity of the heating elements. It is shown diagrammatically in Fig. 10 and consists fundamentally of two resistances A and B connected to the secondary of a potential transformer into whose mid point the line current is introduced. The letters E and I indicate the respective instantaneous potential and line currents in the meter circuit.

The heating in element $A = R_A (I_e + I_1)^2$
$= R_A (I_e^2 + 2I_eI_1 + I_1^2)$

[1] Proceedings A. I. E. E. vol. 34, p. 2279.

The heating in element $B = R_B (I_e + I_1)^2$
$= R_B (I_e^2 - 2I_eI_1 + I_1^2)$

Difference, when R_A and R_B are equal
$= (R_A + R_B)(4I_eI_1^2)$

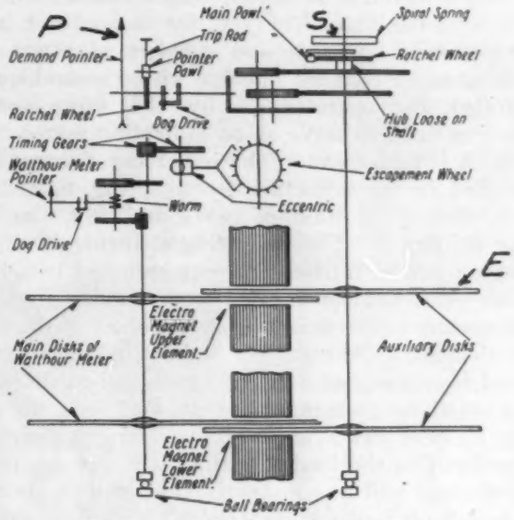


Fig. 8. The Westinghouse R O Meter

That is, the difference between the heating in the two elements is proportional to I_eI_1 or to the power, under all conditions of wave form and power factor. If the temperatures of A and B are made proportional

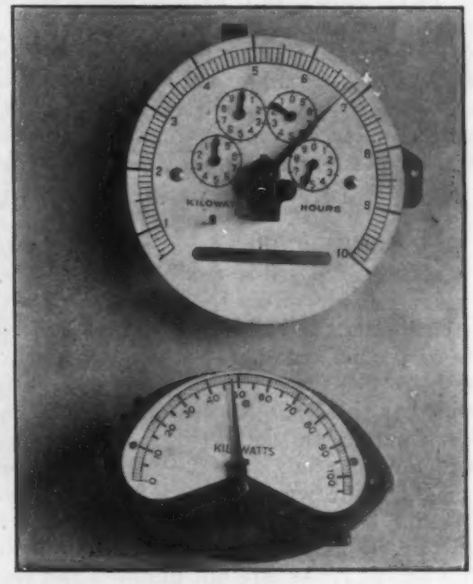


Fig. 9. Typical Face Appearance of Time Lag Type of Demand Meter

to the heat losses, then it only remains to find an indicator of these temperature differences to have a record of the power.

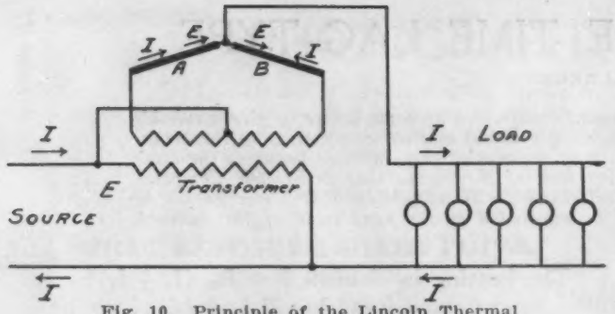


Fig. 10. Principle of the Lincoln Thermal Demand Meter

Westinghouse R O Meter

This instrument is shown diagrammaticay in Fig. 8. It is of the induction type, for use only on alternating current circuits, and consists of a standard watthour meter element and disc with a second spring-controlled disc operated on by the same torque-producing field, to serve as an indicating meter. The operation is as follows: The indicating element, E is controlled in its deflection by a spring S, and actuates, through a train of gears and dog, the indicating pointer P. The indicating element also drives through a pawl a ratchet and gear mounted loosely on its own shaft but constrained from turning freely by an escapement claw driven from the shaft of the watthour element. That is, the indirecting element is allowed to advance at a rate proportional to the speed of the watthour element, or to the load. As the indicating element has a uniform scale with a deflection proportional to the load, the time for it to attain the full deflection will be constant. That is, if it advances at a rate S on a one kilowatt load, it will advance at rate 2 S on a two kilowatt load but will have to deflect twice as far so that the time required for full deflection will in each case be the same.

When the load falls off the indicating disc drops freely back and comes to rest in a new position where the pawl picks up the ratchet wheel and the disc is again restrained from advancing.

This meter has the great advantage that it is self-contained with no separate timing device involving electrical contacts. Records covering many months show that the majority of meters operate satisfactorily, the indicating element being occasionally out only a few per cent. The recording element has proven very accurate.

On the other hand, the spring in such a meter is always a source of possible trouble and in this case the spring and disc combined have a temperature coefficient that under California conditions may make a difference of five per cent between summer and winter readings.

Trouble has also been experienced with the escapement claw binding on the teeth of the escapement wheel,, which occurs only at very light loads, stopping both elements. The watthour meter has a great advantage in this respect in that of whatever make, capacity or type, its dial has but one appearance and is read in but one way. Where one hundred and seventy thousand statements must be read and billed each month, this is a matter of great importance.

The pointer advances by steps of one-twentieth of a division each so that the maximum load is always in doubt by that amount. Furthermore, due to mechanical inaccuracy, the pointer does not always come to rest opposite division markings so that there may be a reading error of half a tenth division. For errors due to above causes to amount to not over five per cent, the deflection must be not less than two full divisions or twenty per cent of full scale. This is often difficult to obtain, particularly on seasonal loads with the current transformer selected for the peak.

The meter has the inherent error of its class previously referred to, with an additional peculiarity. Owing to the fact that the indicating element may drop back freely as the load falls off but may not advance, if the load is fluctuating periodically, due to a compressor or hoist for example, the meter cannot indicate even approximately the average load. This means that the nature of the load must be carefully considered before this type of meter is used.

The R O meter is in general designed for full scale deflection at 50 per cent overload, but as the meter will rarely be used without current transformers, which are never overloaded, it means that the upper third of the scale is useless. The first meters of this type were designed for 100 per cent overload but a reduction to 50 per cent overload was conceded in answer to strenuous protests demanding a meter with full scale deflection at full load.

The dial of the R O meter is shown in Fig. 9. The manufacturer's present standard is a dial graduated in kilowatts instead of in one hundred divisions, which has the advantage of applying the same instrument transformer constant to both indicating and recording elements. However, the writer has always demanded meters with the hundred division dial in order to eliminate errors in statement taking and billing, to which end it is considered advisable to have as few kinds of dials as possible.

(Continued from page 390)

f. 8 is $2 \times$ f. 16.

$\therefore$ f, $8 = (2)^2 \times$ U. S. 16

f. 8 = U. S. 4.

Thus knowing the correct exposure at any stop in one system, the correct exposure for any other stop in either system may be found.

Lenses are rated for the largest opening at which they will operate successfully, and this is called the speed of the lens. However, corresponding markings on all lenses will give the same exposure. For instance a rectilinear lens which has a speed of U.S. 4 (f 8) is faster than a meniscus lens, but 38 per cent slower than an f 6.3 anastigmat, and only 1/3 as fast as an f 4.5 anastigmat. Yet when each lens is stopped down to 16 (U. S. or f) the operating speed is the same for all, since the effective opening is the same. Referring again to the figure with table No. 1, an advantage will be found in the faster lens stopped down. This is due to the fact that the center of the lens only is used and the image is consequently more clear than with the smaller lenses. Wherever possible, it is best to use stop 8 or smaller so that the focus will be more nearly universal. Fig. 2 was taken with stop 16, 1/25 second on a bright summer day with the focus set for 100 ft. However the riffles on the water in the close foreground are clearly shown. Had a larger stop been used, the depth of field would have been noticeably less.

SHORT JOURNEYS IN PACIFIC LANDS

(Little journeys to Pacific Lands are increasing in number and importance. Engineering and commercial relations are fast being established by pioneers from America who are visiting these lands and forming firm and lasting friendships with our foreign neighbors. The author of the following article is making a tour of all the principal West Coast points of Mexico, Central and South America, in which he expects to consume something like twelve months in an exhaustive study of commercial and engineering relations. His reports, which will appear from time to time in the columns of the Journal of Electricity, should prove of unusual value to engineers throughout the West in that the author is thoroughly familiar with hydroelectric conditions, having been at one time commercial engineer for the Southern Sierras Power Company and a contractor of large transmission line construction in the West.—The Editor.)

THE WEST COAST OF MEXICO

BY J. W. FINCH

The Pacific Coast is just awakening to the vast opportunities offered by her neighbors, the wonderfully rich Latin-Americas. Abounding in minerals, tropical fruits, coffee, cacao, hardwoods and innumerable of nature's gifts, her peoples friendly and welcoming American enterprise, this is a field we can no longer afford to leave undeveloped. Southern California has enjoyed considerable business with the west coast of Mexico and some comparatively small business with some of the Central American republics. San Francisco and Puget Sound ports have for years been shipping goods of many kinds to Mazatlan, the principal port of entry on the west coast of Mexico, to Guatemala, Salvador, Honduras, Nicaragua, Costa Rica and Panama in Central America and Colombia, Peru, Ecuador and Chile, and in some cases to Bolivia, in South America. You have only to refer to your map to realize the advantageous geographical position of our own west coast with the west coast of the countries I have mentioned.

Modern Business Structures in Mazatlan, Mexico, with Street Scene Awaiting the Advent of Efficient Transportation Facilities

Eastern markets have been, and are now, shipping through New York and New Orleans to east coast points and thence overland, to supply the western markets of Central America and through the Panama Canal direct to the west coast of South America. European markets have sent their ships direct to these countries and until forced to curtail their exporting they controlled the greater bulk of the business. While we have been content to remain at home and graciously accept such export business as has been offered us, sending our representatives to these lands only occasionally, Germany, England, Belgium, France and Italy have canvassed the field thoroughly with greater or less success. Germany in particular has been a great factor in this field on account of her aggressive sales methods and in a great measure, because of the cheapness of her export products and the long time credits she has extended. For many years we feared to enter in competition because of these conditions, but since a few enterprising Americans succeeded in introducing our goods, the superiority of our products as a whole is being recognized and we are able to sell at higher prices and our goods are continually gaining in prestige. Some American concerns and individuals have abused the confidences gained and we will find some opposition to our business methods, but by carefully studying the demands of the countries and the characteristics of the Latin people we should be able to establish a lasting fellowship and profitable business relations with them.

The writer is embarking on a commercial trip, covering the southwestern portion of Mexico, the Central Americas and the west coast of South America, in the interests of a group of Los Angeles and San Francisco manufacturers and jobbers. A number of non-conflicting lines are to be represented, with a view to establishing permanent relations and studying trade conditions in the countries visited. In preparing for this journey there was naturally the desire to learn something of the countries to be visited, the characteristics of their peoples, their methods of doing busines, the class of goods generally imported, transportation facilities, hotel accommodations, etc. Considerable difficulty was experi-

enced in obtaining specific information along these lines. There are a number of publications pertaining to the subject, but they deal mostly in generalities, and while of considerable assistance in making one's plans and preparations, there are many things that must be learned by experience.

The first question is transportation; to reach Mazatlan, Mexico, it is possible to go by rail over the lines of the Southern Pacific Company, through Nogales, Arizona. From there trains are operated three times a week although accommodations are very poor. At this time trains are not operated at night in Mexico and passengers are required to stay over-night at hotels along the line. It requires five days by train from Los Angeles to Mazatlan. This point is best reached via the Pacific Mail Steamship Company's steamers which leave San Francisco every ten to fifteen days. The time consumed is six days and while some of the boats are old and slow the service withal is very good and the trip is usually a very comfortable and delightful one. These boats proceed from Mazatlan, south, touching at important points along the west coast of Central America and passing through the Panama Canal to Cristobal, C. Z. If one contemplates proceeding directly to Central America, considerably better time could be made by journeying to New Orleans over the Southern Pacific Railroad, then taking one of the commodious steamers that run from there several times a week, across the Gulf of Mexico and proceeding overland to the west coast. If one should decide on this route, inquiries should be made regarding railroad connections in the countries to be visited.

It is now necessary to have in your possession, a United States passport before being allowed to enter certain countries. Your steamship agent will probably advise you to the contrary, but some travelers have had some sad experiences because they were not so prepared. Application can be made for a United States passport through the clerk of the United States District Court in San Francisco or Los Angeles, which application is sent to Washington for the signature of the Secretary of State. Our government will not now issue passports for travelers going into the Republic of Mexico, but one should be obtained from the Mexican Consul General at San Francisco. Before issuing a passport the Mexican Consul requires a letter of introduction from some high public official or from the chief of police in your city, which letter is retained in his files.

The passage from San Francisco to Mazatlan, Mexico, is a very delightful one when the sea is quiet and the weather moderate as it was on our trip. As we get into Mexican waters the sea becomes smoother and the weather slightly warmer. Life on shipboard does not become monotonous as various diversions are offered and many interesting persons are encountered. We were due at Mazatlan early in the morning, but on account of a heavy fog we lay in the stream until the early forenoon, then proceeded to our anchorage about a mile off shore. On account of this port's shallow harbor it is not possible for ocean going steamers to enter. Passengers are disembarked by means of gasoline launches and at low tide are transferred from the launches to row boats, which are beached. They are then carried ashore on the backs of the "boteros" or boatmen until the boat is lightened enough to allow it to be pulled up out of the water. Trunks and hand-luggage are brought ashore in the same manner. When the steamer first comes to anchor, it is boarded by the immigration officials who unwind a long reel of red tape, scrutinize all of the passengers whether bound for Mexican ports or farther south, examine carefully the passports and require all the officers and crew to pass before them, before allowing anyone to land.

In the meantime a swarm of launches, row boats and lighters approach the steamer awaiting the departure of the immigration officials. The "estibadores" or stevedores then scramble aboard followed closely by the launch men who begin bidding against one another for the privilege of carrying passengers and luggage ashore. This expense must be borne by the passenger in addition to his steamship ticket. The amount you pay varies with your ability to bargain with the "lanchero." All freight for this port must be transferred to lighters and then towed by a tiny tug boat to an equally tiny wharf. At high tide the lighters unload directly on the wharf by means of a crude boom derrick operated by hand and when the tide is low the lighters are loaded and unloaded by a string of "cargadores" or porters who wade out into the water, sometimes waist deep, and carry the freight ashore on their heads. The load is supported by a round pad, high up on the back between the shoulders. The pad is attached to the forehead by a broad strap. They are able to carry very heavy loads in this way, pieces weighing 100 kilos (about 220 lbs.) and sometimes heavier, are handled with comparative ease. At one time a number of gasoline hoists or cranes were installed for the purpose of handling freight from the lighters but these were not welcomed by the "cargadores" and a strike was the result. The use of the cranes was therefore discontinued and they are now lying idle.

All freight entering is passed directly through the customs house for appraisal. Passenger's baggage is of course inspected and particular attention is paid to anything which is packed in a box or nicely wrapped, even though it is in a trunk or hand bag. My experience with the customs house here was interesting. Several samples which I am carrying with me were passed through without any comment although one sample which weighed five kilos was assessed for a small amount. All personal wearing apparel was passed without comment except three cardboard suit boxes were in a trunk of my wife's clothing. These boxes were in a trunk and were used merely to protect the articles which they contained. The fact that the clothing was carefully wrapped and in the boxes was responsible for an assessment of $48.25 Mexican silver. I protested of course and after much discussion the assessment was reduced to $29.00 which I had to pay. Had this clothing been packed loosely in the trunk without the boxes it would have undoubtedly entered free.

American money is accepted freely here and is quite commonly used, although the rate of exchange is $1.80 Mexican silver for $1.00 American silver or currency, or $1.95 Mexican silver for $1.00 gold. The rate of exchange is revised every ten days by decree from the capitol. Merchants generally pay for their goods with United States currency and as there are no banks here at present it is difficult to obtain drafts on the United States.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

(Cost data per acre foot for different capacities of unlined reservoirs have long been lacking. Below will not only be found curves that cover this important relationship but a section showing all details in the construction of a typical unlined earth reservoir is given. The author is a well-known irrigation specialist at the University of California and as a consequence this information should immeasurably forward the use of economic application of electrical energy in pumping where unlined earth reservoirs are necessary.—The Editor.)

UNLINED EARTH RESERVOIRS FOR PUMPING PLANTS

The greater proportion of reservoirs used with individual pumping plants are constructed entirely of earth. Where the soils are too light to prevent seepage various kinds of lining such as clay puddle, manure, oil or concrete may be used. The unlined earth reservoir is the cheapest form and where the soil is a compact silt loam or heavier can be made sufficiently water tight for most purposes at small expense.

Earth reservoirs for pumping plants are usually constructed by excavating the material for the banks from the inside area. For each size of reservoir there will be a certain depth of cut over the inside area which will furnish sufficient material with which to construct the banks. The greatest capacity in relation to the material in the banks is secured in a circular reservoir. Earth reservoirs are practically always built either square or rectangular in shape as the saving in material with a circular form is small and the irregular areas of land not in the reservoir are of little other use. Circular concrete reservoirs are frequently built.

Reservoir Banks.—A bank which has to withstand the pressure of water has a very different duty to perform than an ordinary earth fill. Flatter slopes are required on the water side to prevent injury by wave action and to increase the distance seepage water must travel through the bank. A slope of one vertical to two and a half horizontal is needed on the water side. Large earth dams even when protected with riprap to prevent wave erosion are usually given a slope of 3 to 1 on the water side. Ordinary earth fills not subject to wave action will stand on slopes of one vertical to one and one-half horizontal and such a slope can be used on the outside of small reservoir banks. This slope is usually on road and railroad fills. On high banks the erosion from rainfall on such slopes may be troublesome, on small reservoirs this is not important.

The banks should be given a top width of 2 ft. in all cases and for the larger sizes 3 or even 4 ft. would be preferable. The width should be greater in lighter soils than in those containing clay.

The full height of the bank cannot be used for the storage of water; some free board as it is called or excess height is required. For small reservoirs not subject to excessive wind action and having banks with the slopes recommended one foot of freeboard should be sufficient. Where linings are used smaller amounts may be satisfactory.

In many cases reservoir banks have been built with steeper slopes and less top width than the amounts stated above. Such banks, however, when in use gradually flatten their inside slopes and reduce their usable heights so that eventually no more storage is available than would have been secured with a well proportioned bank containing the same amount of material. The use of light banks increases the material danger of breaks during the period when adjustment is taking place.

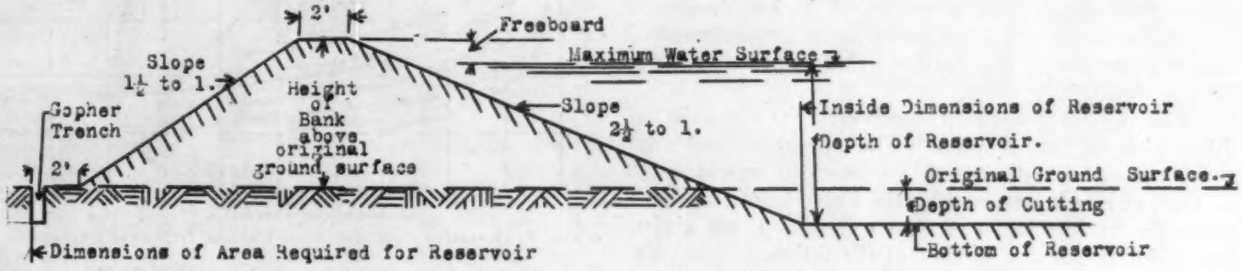


Fig. 1. Section of Reservoir Embankments

In building the banks, the ground should be cleared and plowed so that leakage along the line of contact between the original ground and the bank may be avoided. In building the banks, the earth should be distributed and the teams driven along the bank so as to pack the fill as it is made.

Where there is a marked prevailing wind from one direction the banks of the opposite side may need protection against wave action. This may be secured by a layer of gravel although gravel is not usually accessible at such reservoirs. A fence consisting of posts driven into the bank about a foot below the high water mark with wire into which brush is woven will usually give good results. Another method is to spread the brush on the slope and hold it in place by wire netting spread over, and held down by stakes. The bank may be given a flatter slope on the side exposed to wave action.

Spillways.—It is sometimes desirable to provide spillways in reservoirs to prevent their becoming too full and overtopping the banks. Where the reser-

voirs are filled from pumping plants spillways may not be provided. If the pumps are operated during the night or at other times without attention such spillways may be desirable. A width of 3 to 5 feet of the bank depending on the capacity of the pump may be cut down to the elevation of safe high water and protected against overflow either by concrete or wood lining. Any discharge over such spillways can be led to the field ditches or into the pipe lines. A vertical pipe may be set inside the reservoir with its top at high water level. Such a pipe or box can be connected with the outlet of the reservoir or with a separate outlet through the bank. The discharge into such an overflow spillway will be similar to that of a weir with a length equal to the circumference of the inlet. In special cases an arrangement of floats can be made by which the power may be shut off when the water reaches a certain height in the reservoir.

Gophers.—Burrowing animals, more particularly gophers, frequently injure the banks of reservoirs by forming openings through which leaks resulting in breaks in the bank may start. Gophers burrow in banks to get above flooding in the fields or to secure food from the roots of vegetation growing on the banks. Keeping the banks clear removes the latter cause. The best prevention is a trench dug around the reservoir having a depth greater than the depth of gopher burrows. Such a trench 18 inches deep will usually be effective. In extreme cases a close meshed wire may be set in the bank so that gophers can not burrow through.

The outlets for earth reservoirs may consist of either pipe or wood boxes. The character and cost of these have been discussed in a previous article.

Cost of Earth Reservoirs.—In Table 1 data on earth reservoirs having banks as shown in Fig. 1, are given. The inside dimension is that of the finished reservoir. The more usual sizes of square reservoirs are included in the table. Reservoirs may be built in a rectangular shape in order to utilize available land. The length of bank required for equal capacity will be greater with a rectangular reservoir than for one built as a square. Estimates of the material required for rectangular reservoirs where one dimension does not exceed twice the other can be made from Table 1 by finding the size of square reservoir having equal area and increasing the material by about 5 to 10 per cent depending on the difference from a square.

The depth of cut over the inside is figured for level land and without allowance for swell or shrinkage in the bank. Where sloping sites are used the height of one bank is decreased and that of the other increased. As the material in a bank increases more rapidly than its height this will result in an increase in the quantity of material on uniformly sloping land for an equal capacity. For the small slopes usually found where such reservoirs are used the difference in the material required on level and on sloping ground is not large.

The area of land required is figured to include the banks and an additional 2 ft. in width for a gopher trench. An allowance for the value of the land used is necessary if the costs of reservoirs of different sizes and depths are to be compared. Land used in a reservoir represents as real a portion of the cost as the expense of construction.

The estimates of cost are based on prices which can usually be secured. Such costs vary with different conditions and the figures given may be exceeded in some cases. This is particularly true of the value of the land.

The cost of earth work is taken as 12c per cubic yard. This cost can usually be secured where the work is well handled. It represents about 40 cubic yards per day for a 2 horse Fresno or 60 cubic yards for a 4 horse Fresno.

In order to compare the relative costs of small deep reservoirs with larger more shallow ones the costs per unit of capacity are given. These figures show the lower unit costs secured in the larger sizes. For a given area of reservoir the unit costs decrease with the increase of the depth when the value of the land is included. For unit prices used in these estimates there is little difference in total cost for the different relations of area and depth which may be used for the same capacity. Reservoirs 100 by 100 by 4, 120 by 120 by 3, 150 by 150 by 2 have equal capacities, the costs per acre foot being $125, $123 and $132 for the unit costs used respectively. For higher land values the smaller and deeper reservoir would give even lower relative costs. From considerations of use and reduction in seepage losses the 4 ft. depths would be preferable even at somewhat higher costs.

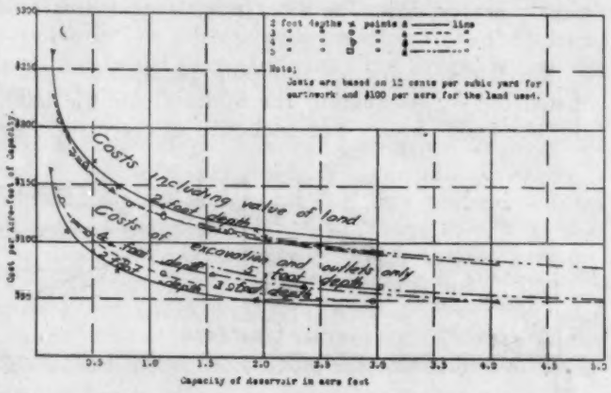

Costs including value of land
Costs of excavation and outlets only
2 foot depth
4 foot depth
Capacity of reservoir in acre feet

Fig. 2. Relative Cost per Acre Foot of Different Capacities

These estimates of relative costs are plotted in Fig. 2. These are given both for construction cost alone and for costs including the value of the land. For construction costs alone the costs per acre foot of capacity are somewhat higher for the deeper reservoirs if a uniform price per cubic yard is used.

If the land is valued at $100 per acre the costs for any capacity show practically no difference for depths of 3, 4, or 5 ft., being slightly higher for 2 ft. depths. For higher land values the greater depths are more economical. At a land value of $100 per acre, the value of land represents from 30 to 50 per cent of the total cost.

As stated these comparisons are based on banks of the recommended dimensions shown in Fig. 1, and for balanced cut and fill on level ground. If the inside slope of the bank is made steeper, the saving in cost is not large. For balanced cut and fill reservoirs with 2 to 1 inside slopes, the difference in cost from those having 2½ to 1 slopes is from about 12 per cent for small sizes to 5 per cent for shallow larger sizes. For 1½ to 1 slopes the saving in cost over those with 2½ to 1 slopes varies similarly from about

20 per cent in the smaller sizes to 15 per cent in the larger.

If no site is available for a reservoir at sufficient elevation so that it can be drained onto the land if built in balanced cut and fill, the banks must be built from earth secured outside the reservoir, the natural ground surface becoming the bottom of the reservoir. This increases the material which must be handled. The percentage of increase in cost varies with the size and depth. For two foot depths of storage the increase in cost over balanced cut and fill varies from nearly 50 per cent for 50 ft. sizes to 10 per cent for the 200 ft. size. For four foot depths of storage the increase in cost varies from nearly 100 per cent for the 50 ft. reservoir to about 25 per cent for the 200 ft. size.

Table 1.—Data on Earth Reservoirs

Inside Dimensions of Reservoir—ft.	Depth of Water Stored—ft.	Capacity—acre ft.	Capacity—gallons.	Height of Bank above Bottom of Reservoir—ft.	Depth of Excavation over Inside to Make Bank—ft.	Height of Bank above Ground Surface—ft.	Total Cubic Yards in Embankments	Total Area of Land Required—acres	Estimated Costs: Excavation at 12c per cu. yd.	Value of Land Used at $100 per acre	Cost of Outlet	Total Cost	Total Cost per Acre foot of Capacity	Cubic Yards Excavation per Acre foot Capacity
50x 50	2	.14	45,000	3	1.1	1.9	110	.14	$ 13	$ 14	$ 10	$ 37	$265	790
	3	.23	75,000	4	1.6	2.4	174	.17	21	17	10	48	209	755
	4	.33	107,000	5	2.2	2.8	244	.19	29	19	10	58	176	740
75x 75	2	.29	94,000	3	.85	2.15	183	.25	22	25	10	57	194	620
	3	.47	153,000	4	1.3	2.7	289	.28	35	28	15	78	166	615
	4	.66	215,000	5	1.8	3.2	416	.32	50	32	15	97	146	623
100x100	2	.50	163,000	3	.7	2.3	270	.39	32	39	15	86	170	535
	3	.80	261,000	4	1.05	2.95	413	.43	50	43	15	108	134	515
	4	1.12	364,000	5	1.5	3.5	593	.48	71	48	20	139	125	530
	5	1.45	472,000	6	1.95	4.05	800	.52	96	52	20	168	116	550
120x120	2	.72	235,000	3	.6	2.4	328	.52	39	52	15	106	148	460
	3	1.12	364,000	4	.95	3.05	520	.56	62	56	20	138	123	465
	4	1.55	505,000	5	1.35	3.65	750	.62	90	62	20	172	111	485
	5	2.01	655,000	6	1.75	4.25	1005	.66	120	66	25	211	105	500
150x150	2	1.10	358,000	3	.5	2.5	422	.74	51	74	20	145	132	380
	3	1.71	557,000	4	.8	3.2	685	.81	82	81	25	188	110	400
	4	2.35	765,000	5	1.15	3.85	975	.87	118	87	25	230	98	415
	5	3.03	986,000	6	1.5	4.5	1312	.92	158	92	30	280	92	435
200x200	2	1.93	629,000	3	.4	2.6	593	1.23	71	123	25	219	113	310
	3	2.96	965,000	4	.65	3.35	970	1.30	116	130	30	276	92	330
	4	4.05	1,320,000	5	.9	4.1	1385	1.38	166	138	30	334	82	340
	5	5.15	1,680,000	6	1.25	4.75	1880	1.46	226	146	30	402	78	365
	6	6.38	2,080,000	7	1.6	5.4	2440	1.54	293	154	30	477	75	380

DRAINAGE AND IRRIGATION BY CORRESPONDENCE FOR FARMERS

To aid the thousands of California farmers who could greatly improve the value of their farms by draining patches of swamp or water-logged or alkali lands, the University Extension Division has arranged for a new correspondence course on "Irrigation, Drainage, etc., for Rural Districts." It will be given by William F. Sullivan, C. E., an expert in irrigation and sanitary engineering.

Besides learning how to rid a farm of ground water and how to drain patches of wet land, the correspondence students will study economical methods of irrigating small tracts from wells and of building small reservoirs and irrigation ditches, and how to handle efficiently problems of the farm home. There will be practical instructions also in how to make good concrete and in how to estimate the cost of masonry work and of irrigation and drainage undertakings.

SUGGESTIONS FOR OFF-PEAK HOURS—I

Whether you are an engineer in the busy thoroughfares of prosperous cities of the West or one of the many necessary links in the chain of operation of one of the mountain hydroelectric plants, the call to the country this season of the year is irresistible. The question often comes to each of us as to how we may pass the time in these off-peak hours to the best advantage to ourselves and contribute to the happiness and enjoyment of those about us.

If you want to be young again and be an agreeable daddy, husband or friend, try a little contest, when next you stroll in the hills. Whether accompanied by daughter, son, wife, sweetheart, or friend, start a little game as follows: One point for each different wild flower you can name, one-half point for those you discover but can not name, and three points for each new discovery you make in succeeding trials. You will soon find that, although you now know but possibly six to ten wild flowers, you will easily enumerate a hundred before the season is over, such will be the results of inquiry, books and other stray sources. And best of all you will soon find that these myriads of little new friends will be playmates for a life time. And friends indeed they will prove—because that grouch you have had so long will soon be replaced by a new outlook on life and service to the engineering fraternity will be blessed by a renewed clear brain of one of its members.

As the welfare of the nation and the nation's defense are absolutely dependent upon an adequate supply of coal for all purposes, and of iron ore for the iron and steel mills, the executive committee of the special committee on national defense, of the American Railway Association, has ordered all railroads of the United States to give coal and iron ore preference over all other traffic.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A SCHNEIDER

(An old sign hangs up in a secluded cabin in the high Sierras which reads thus: "God helps them that help themselves, but God help the man that's caught helping himself here." Below will be found an interesting article on helping the electrical dealer to help himself. The article is written by the power apparatus specialist of a well-known supply house in San Francisco. Read it. It will certainly help the contractor and dealer to help themselves and we feel quite sure the calling in of the Almighty to wreak vengeance as stated in the cabin sign above mentioned will never take place. Other interesting and helpful articles on heating of flood lighting projectors, ordering switches and fuses for single-phase motors, and precautions in testing dry cells may also be found in this department.—The Editor.)

HELPING THE ELECTRICAL DEALER TO HELP HIMSELF

There are very few things on this old world of ours that really "happen"—there is a well defined reason back of everything. And above all the shining examples of this homely truth there is business—Business does not happen—it is created, and it is the successful merchant, whether he be an electrical dealer or a dry goods man who knows how to use all the tools at his disposal to create business and profits.

The electrical dealer has been backward in his attempt to create business. He has stocked his store with merchandise, put a few miscellaneous items in his window and then set back and waited for something to "happen." Nothing does, and thereby hangs this tale.

Now let us assume that the dealer has fixed up his store interior, has a nice gold lettered sign hanging before his door, and his name in shining gold-leaf letters across his window. His first line of attack is his window. To put a first-class, attractive, timely, business-getting display in his window is his first duty. "But" says the dealer, "I know nothing about window displays—I can't trim a window so that it will look and be attractive. Further, I can't letter signs and it's too expensive to have them lettered."

What an unfortunate man indeed is the dealer who will not take his eyes off the ground. Electrical distributors and manufacturers know that it pays them to help the dealers help themselves. So a number of them have developed an extensive window display service through which the dealer receives all the necessary display material to set up a window display that will fulfill all the duties and requirements of his particular window and business. There are displays for lamps, batteries, washing machines, vacuum cleaners and irons; and there are displays around the many holidays and seasons. For instance, this service includes displays for Easter and Fourth of July, Washington's Birthday, and so on. This service is complete and is one of the most important tools at the dealers' disposal to create business.

Next comes the envelope stuffer. Nobody familiar with business getting methods questions the efficacy of the envelope stuffer which is nothing more than a small folder designed to fit in an envelope and be enclosed with a letter. These little folders properly designed pave the way for many a sale of the commodity they advertise. But these stuffers are expensive to produce in small quantities—quite too expensive for the electrical dealer. So the electrical distributors have printed them for the dealer who gets as many as he wishes on any appliance that he wishes —and he gets them for the asking—all imprinted with his name and address and ready for work. These stuffers are never designed to lie around on shelves and counters collecting dust. They are designed to be mailed to customers with bills and letters to collect business. Stuffers are like shells—which you know are effective only when they are shot from the guns for which they were designed—shells stacked nicely on the ground are pretty to look at but they'll never win a battle there.

Next we come to newspaper advertising. Nobody denies the business pulling power of an effective newspaper ad. The reason nobody denies it is simply because there exists nobody today who at one time or another has not bought something directly because of the influence of a newspaper ad. And so the electrical dealer can profitably employ newspaper space to sell the merchandise he has upon his floor and shelves. But where is there the electrical dealer who can design an ad. that will have the desired results? They are few and quite far between. That in no way is a slur on the dealer's ability—it takes a certain specialized skill to write a business-getting ad. and the large electrical distributors have men who write ads. of this character and do nothing else. The fruits of their labors are given to the dealer for his use. He can get newspaper ads. on any article he desires, in any size he desires—by asking for them. Simple enough, isn't it?

And then there are letter-head electrotypes, lantern slides, moving pictures and any number of special helps that the dealer can get to increase his sales which really means an increase in the sales of the people who sell him his merchandise.

The free printed matter, the free lantern slides and the free newspaper electrotypes are offered not in an altruistic spirit, but because it is good business —good business for the manufacturer and good business for the dealer who is progressive enough to use them. Let the dealer remember that he is one of the outlets, that is, one of the channels of distribution. In other words, the manufacturers are the generators and the dealers are the service leads that provide an outlet for the goods of the manufacturer; and when the service leads or dealers are a satisfactory outlet, the manufacturer accomplishes his purpose and he benefits—but do not forget that the dealer benefits too. The manufacturer sells to the dealer and provides him with the means for reselling these goods to the ultimate consumer. The manufacturer is desirous of having the dealer sell his goods so that the dealer will be in a position to buy and sell again.

Of course, the manufacturer profits—but doesn't the merchant profit at the same time?

One of the vital points in connection with dealers' helps—one that is so often under emphasized and little appreciated by the dealer himself—is the relation of these sales helps to the National Advertising Campaigns in which thousands of dollars are being spent to create a demand for electrical appliances. If when this demand is created there is no way of cashing in on it, all the advertising avails the National Advertiser nothing.

One case in point—that of the Western Electric Sewing Machine that is being nationally advertised. These national advertisements are creating a desire on the part of the women readers to own or at least to know more about one of these machines. Now no woman is a mind reader—she cannot instinctively know that John Smith handles this machine in her town unless John Smith tells her. John Smith can tell every woman in his town that he handles the machine—he can tie up to and cash in on the national advertising and the demand it creates. He can do all this by using his dealers' sales helps. If this John Smith is on his business toes he will have a lantern slide in the movie theatre telling that he handles the sewing machine that is so prominently advertised. He will run an ad. in his local newspaper telling about his store and the sewing machine he handles, and lastly he will have a sewing machine display in his window. If he has prepared himself this way, no woman in his town will fail to connect his store with the nationally advertised sewing machine—and the constant bombardment she receives from his advertising artillery will finally make her capitulate and the sale is easily made. And what is true of the sewing machine is likewise true of the washing machine, the vacuum cleaner and all the appliances the electrical dealer handles. No electrical dealer will complain of poor business if he goes after good business. No business is really poor—some businesses are simply better than others, and the best business is always the one that is best advertised.

It is the wise electrical dealer who knows his own game and knowing it, plays it to the limit. That is all this electrical business is—a great big game—with a zip and a zest to it so often lacking in other businesses. And the electrical dealer is doubly fortunate because he holds all the trump cards—every sales help is a trump in the sales game—how long will he continue to hold the big cards and play the little ones? How long will he refuse to see that it's the trump cards that take the tricks? And how long will he keep on doing a socket business when, with a little judgment and the judicious use of the advertising matter he has at his disposal,—he can sell the big appliances—sales that make the old cash register bell ring with joy?

HEATING OF FLOOD LIGHTING PROJECTORS

Flood lighting projectors should not be used in show windows or under similar conditions even for temporary installations unless ample ventilation is provided. These devices are not designed for indoor service and where space is restricted or ventilation poor they are likely to heat up to a dangerous temperature, especially with lamps of the larger sizes. In any case the arrangement of the window should be such that inflammable materials are not liable to come in contact with the projectors. Further, the conductors should be of ample size and of the slow-burning or asbestos covered type.

A case in which these precautions were not observed came to the writer's attention some time ago. A projector having a 250-watt lamp was placed in a small store window which was completely enclosed. In a very short time the lamp became so hot that the filament drooped and produced a short-circuit, which might have caused overheating of the leads, which were of ordinary No. 18 cord, had the circuit not been properly fused.

In anticipation of the dangers from overheating of high wattage lamps improperly installed, rules governing such installations were incorporated in the National Electrical Code some time ago under the caption "Gas Filled Incandescent Lamps." This section should always be consulted before making such installations.

ORDERING SWITCHES AND FUSES FOR SINGLE-PHASE MOTORS

Single-phase motors of the repulsion induction type have the windings connected so as to permit operation on circuits of either 110 or 220 volts. This is accomplished by bringing out four leads—two from each half of the winding—by means of which the windings can be connected in series or parallel according to the circuit voltage.

In ordering switches and fuses for this type of motor it is therefore necessary to specify on which voltage the motor is to be operated since the capacity of the switch and fuses will depend upon the voltage.

This point is overlooked nine out ten times and is the cause of many delays in handling such orders.

PRECAUTIONS IN TESTING DRY CELLS

Do not test cells while they are cold. Before testing put them in a moderately warm room for 24 hours.

Be sure that the ammeter is reasonably correct by checking it occasionally with a standard ammeter.

Wires on the ammeter should not be more than 12 inches long and not smaller than No. 12 wire.

Hold the terminals of the ammeter on the binding posts—not on the carbon.

Do not keep ammeter in circuit more than 3 seconds. Otherwise the short-circuit will exhaust the cell.

OIL FOR SMALL POWER MOTORS

A prominent manufacturer of motors and fans gives the following information about oil for small motors: The best oil for small motors is a medium weight mineral lubricating oil. Thin oils, such as used for typewriters, guns, etc., will not give satisfaction, and should not be used. A heavy oil, such as cylinder oil, will gum the bearing and be likely to ruin the motor. For the same reason only clean oil should be used.

Do not use vaseline for motor bearings. Never use any vegetable or animal oil, such as lard, linseed, cottonseed or olive oil. They are not lubricants.

PACIFIC COAST SECTION N. E. L. A. CONVENTION

(Hydroelectric activities throughout the West have assumed a serious, sober tone of expression due to the present critical state of affairs in the national government. It is now recognized that vast service can be rendered the national government by keeping such utilities in efficient and effective operation. The Pacific Coast Section of N. E. L. A. is fortunate in having as its president one who is well qualified, through long years of military training combined with operating of utility organizations in civil life, to render unusually effective service at this time. In the next issue of the Journal full announcement of new committees and new activities for the year's work will be set forth by Captain H. F. Jackson, president of the Pacific Coast Section. Below will be found the first installment of transcribed notes taken at the recent Riverside convention.—The Editor.)

FIRST ANNUAL CONVENTION, NATIONAL ELECTRIC LIGHT ASSOCIATION, PACIFIC COAST SECTION

Riverside, Cal., April 19, 1917, 2 o'clock P. M.

President Ballard: It becomes my privilege, and I consider it a very great honor, to call to order the First Annual Convention of the Pacific Coast Section of the National Electric Light Association. We have come from hundreds of miles apart to meet here in convention for the first time.

I believe that one of the main things which we will all get out of this convention particularly is the value of getting personally acquainted one with the other. We must all come out from under the naturally modest and retiring disposition of all electric and utility men and greet each other. The officers cannot, of course, go around hunting up all the members of the association, but the officers will all of them be very glad if the members will hunt them up.

I shall be very happy if this convention will rest in our memory as an unconventional convention. In many respects I think it will be different from the ordinary conventions which some of us have been used to. We had our organization meeting in Los Angeles in January. We received two invitations to come to Riverside. The first of these was from the Southern Sierras Power Company through its vice-president and general manager, Mr. A. B. West. As a fitting punishment to Mr. West and as a test of his loyalty to the organization we appointed him as chairman of the convention committee. You will see as the convention proceeds how right royally Mr. West has risen to his task.

Riverside is an ideal convention city. It is noted throughout the world for its hospitality and its beauty. Riverside is a progressixe city in principle and performance. There were wonderful roads in this section of the country before the value of good roads throughout the State of California was known. We have in Riverside also one of these municipal electric systems we hear about occasionally. This system, however, was not built as a destroyer or to compete with an existing investment, but to fill a need for service where no service existed. I think it is quite a remarkable showing when we remember that for the past twenty-five years the city of Riverside and the power corporations of this vicinity have worked harmoniously together to give service to the citizens of this city.

CAPTAIN H. F. JACKSON, PRESIDENT PACIFIC COAST SECTION, N. E. L A.

Born in the Middle West, trained at West Point, tried by fire during the Spanish-American War in Cuba, experienced as acting chief engineer of the Seventh Army Corps, backed by twelve years of executive life in operating one of California's greatest hydroelectric utilities, Captain H. F. Jackson, the newly elected president of the Pacific Coast Section of N. E. L. A., presents an unusual dovetailing of the man and the place for the effective piloting of the great utility activity of the West through the present national crisis.

We are honored today by the presence of the Mayor of Riverside, and at this time I have very great pleasure in introducing to you the Hon. Oscar Ford, mayor of Riverside. (Applause).

Mayor Ford: Ladies and gentlemen and delegates to the Convention of the National Electric Light Association, Riverside feels highly honored in being the first place where your convention is held. We have known something of the members of your organization here. We have done business with them, as your president has said, for twenty-five years. The business and other relations which we have had with you people have been entirely satisfactory on the part of the city, and we hope they have been profitable on the part of the members of your association with whom we have done business.

As stated by your president, in the beginning, our plant was organized not to compete with any already existing plant, but to get light, which we much needed at that time. In the beginning we issued bonds for $20,000, thinking we were going to build an electric power plant or something of that kind, and after the money was obtaned it was found that we b a r e l y had enough funds to build a line up above Redlands in the mountains where there was a plant already established, and this was done. Afterwards it became necessary to put in a little steam plant as auxiliary to the power which we were getting from the old Redlands Electric Company, as I believe it was called in the beginning. Since that time we have added to our distributing system but have not added to the power plant whch we use only now in case of emergency.

The greatest thing in the world, of course, is the people in the world and the greatest people in the world are those who do things. I don't know of anything that anybody could do that would be of more importance or be of more benefit to the people with whom they do business than in bringing light and power into the communities for their benefit. The light which you furnish goes into every street and every residence and every public building in this city and, aside from whatever profit you make out of it, you are doing a great thing for this community and the community appreciates it.

We are very glad to have you here in convention and we hope that you will make yourselves at home; that you will feel that this city is your city for the time that you are here,

We hope that the light of your countenances will still continue to shine on us as in the past, and that the power which you furnish may be used for the mutual benefit of yourselves and our people. I might have said that many of the orange groves which are on the higher lines here are only possible through the advent of the power which we get here, the water being pumped onto the high hills, making these groves possible; and we hope that in a friendly way the warmth of your friendship may be ours for all time to come. I thank you, gentlemen. (Applause).

President Ballard: A second invitation we received to hold our first meeting in Riverside was from the Riverside Chamber of Commerce. We had expected today that the Chamber of Commerce would be represented, but, due to the pressure of work in connection with the state defense matters, that pleasure will not be ours. On behalf of the association there is no one better qualified to respond to the eloquent remarks of Mayor Ford of Riverside than our much beloved dean of the electric light industry on the Pacific Coast, and I take great honor and pleasure in introducing to you this gentleman. He needs no introduction at my hands. Mr. John A. Britton of San Francisco. (Applause).

Mr. Britton: Your honor, Mr. Chairman, and gentlemen, I feel within this sanctuary like quoting from the scriptures in order to start right. Usually we end with a benediction. I am going to begin with one, applicable not only to Riverside but to the entire southern part of the state.

My sermon is taken from the fourth chapter of the gospel of humanity, beginning at the first verse: "I was a stranger and ye took me in." Riverside in common with all Southern California, has taken us in, not in the sense that might be applied when a public utility man deals with a consumer but from a broader view. My objection as a member of the family living north of Tehachapi is that when Riverside and Southern California take people in they keep them too long. When they arrive up around the bay of San Francisco they are frazzled in body and purse and they are looking for the first train out to get back home.

But can you blame them? Hospitality in California is well known. It always begins with a capital letter. But here, amid these wonderful orange groves, these hills crowned with snow shining upon the vales and valleys below, rich in their verdure of green and all the colors of the spectrum, they spell hospitality with capital letters all the way through and they don't remind you of it. It is unostentatious.

You are taken unconsciously into their hearts and into their confidences,—particularly into their confidences when they tell you of this vast domain of wonderful growth and life of this wonderful production of fruits, flowers and sunshine. They confide that, not in a whisper but from the mountain tops and to all the world, and I care not where you go, whether in the plains of Africa, the steppes of Russia, the fields of Italy or the tops of the Sierra Nevada Mountains, you will hear nothing but Southern California. And as I said a minute ago, it is deservedly so, because the word hospitality means all that is expressed in the lexicon and then some, and we of the north a little more cold blooded, perhaps, in our actions and demeanor, have many a good lesson to learn from these people in the south that have made of this arid desert, as it were, a garden of Eden here in California.

I want the honorable mayor to realize that as much as I esteem Riverside and the way it has been keeping out of the municipal plant game as it is usually played, that I want him to appreciate how it has been done and by what means and through what sources.

The industry which we represent, your honor, is an infant. It can be traced back in its early activities not over thirty years. There is hardly a man in the room today who was not born when electricity began to take this place among the sciences of the world. Nearly seventy-five years after gas had been discovered and put to practical uses and it was found that that good old illuminant could not do the things which in the progress of science and the advance of the nation it was needed to do, and there came men to the front who discovered that illuminant which we knew nothing about and that today is the power of the world for the good of all the world, because since the advent of electricity in its many phases, beginning with the telegraph, then the telephone, then lighting, and then its many uses for power, and then wireless telegraphy, and then wireless telephony, it has revolutionized the world and made possible the electrical industry. So today, placed as this nation is, it is better prepared to do its part in the defense of the nation than ever it was before in its history, and it is due to the growth and development of the science which these gentlemen so well represent.

Today, if by any catastrophe, if by any mistaken act of the government, the electric companies of this state particularly were deprived of their power to render service, chaos would come; destruction would come to this beautiful city,—because there is no state in the United States, no territory in all of Europe, that depends so much upon the uses of that subtle fluid that you control than does this state. If the power possibilities from the western slope of the Sierra Nevada Mountains could be taken off to some of the other states in the union, more congested in population, more good would result; but here, as it happens, no industry of any consequence, no government works, no coaling station, no city, no farm, but what is dependent first upon the falling waters of our streams and then upon the power created thereby.

This state has made its name and its mark through its men in the development and progress of this wonderful art of ours. In amount of kilowatt hours consumed per inhabitant we stand first; in low cost of power, we stand first. That has been done by bone and sinew and the brains of men that are here today, your honor, for the purpose of giving to the public and to the state, and, if need be, to the nation a better service and a cheaper service.

This is a disinterested crowd of men excepting in the one thing that they are intent upon doing for the benefit of the people, from the operator in the station to the manufacturer who supplies the material; and we challenge any state to bring together a more representative crowd of men, men who are doing things. We lack in this world not the man who says things so much as the man who does things, who makes things and who makes them go. That is the type of men you have here. I venture this assertion: That in every one of the territories in which these men are engaged or employed, that if any public matter arises, they are the first men called into council by the municipality of the city or the nation to confer with upon matters of importance. And our councils in Washington are made up of technical men in our profession; our councils here in the same way. It is because these men are not laggards. They are men who are active, energetic, brainful and ready to give their might in the preservation of the nation if called upon so to do.

We thank you, Mr. Mayor, for your hospitable greeting. We will take advantage of it. There won't be a nook or corner of your town that we will not visit. And we ask you as a matter of caution, in closing, if you will be kind enough to advise the chief of police, if you have one, that the men who wear this badge are immune at this time from any sort of punishment, (laughter and applause). We can feel perfectly free now to accept the hospitality unreservedly, and you need not take your latch keys away with you unless you wish. I hope you will make occasion to visit the part of the state from which I hail. I hope you will bring with you that sunshine and hospitality for which you are noted. I can assure you if you do come we will try to return in part the splendid welcome you have given to us. (Applause.)

H. F. Jackson, vice-president, assumes the chair.

Vice-President Jackson: On behalf of the association it gives me pleasure to request your president to give you the benefit of a few remarks at this auspicious time.

President Ballard: Members of the association, it has always been customary in associations of this kind that the president shall make what is termed an address, and, following that custom, I have such a document with me. I will now deliver it to you, trusting that you will sit with what patience you can muster, through to the end.

(See page 353, Journal of Electricity, May 1, 1917.)

President Ballard re-assumes the chair.

President Ballard: We will now have reports from some of our officers. The secretary of our association has been on the job strenuously, day and night, ever since our organization meeting, and it is largely due to his efforts that we have reached the point of membership and organization which we find ourselves in today. We will be interested in hearing what our secretary has to say at this time, and I have great pleasure in presenting to you Mr. Halloran of San Francisco.

Report of the Secretary

To the President of the Pacific Coast Section, National Electric Light Association:

During the past three and one-half months the Pacific Coast Section has evolved from a brave idea to a virile reality. Starting on the 6th of last January with a membership of less than 300, on the 15th of April it boasts a membership of 1419.

In point of numbers as well as of area, the Pacific Coast Section is already the largest geographic section in the United States, notwithstanding the fact that its four states have the lowest density of population of any section in the National Association. This phenomenal growth has been due to the energetic and enthusiastic efforts of its officers and committees who have crowded into three months' time work that would ordinarily have occupied a year.

But mere numbers by no means represent the worth of the association. Equally remarkable are the papers and reports which have been prepared by the several committees for consideration at this, our first annual convention. These are without exception of the highest grade and should do much to bring about a better understanding and speedier soltuion of the engineering and commercial problems which are peculiar and common to this great territory. The convention papers were printed in the Journal of Electricity of April 15th, see page 15.

This section has been the first to give serious consideration to unifying the several branches which constitute the electrical industry. Originally a central station organization, it has been greatly broadened so as to include in its membership a large representation of the manufacturers, jobbers and contractor-dealers. Steps have been taken to give each of these interests adequate representation on the executive committee at this meeting and in the commercial committee's report especially are recommendations which should do much to advance the material prosperity of each sub-division.

It has been the privilege of your secretary during the past few weeks to personally visit the plants of nearly every one of the fifty class A members of the organization. In this way, it has been possible to learn the local conditions which each company has to meet and thus bring about a more intelligent conduct of the section's activities.

At this time it seems wise to suggest that inasmuch as the smaller companies outnumber the larger companies three to one, that particular attention be devoted to promoting the welfare of the smaller companies. They can learn much and profit greatly from the experience of the men in the larger companies.

With so much cause for congratulation, we should not overlook certain shortcomings which have yet to be corrected. The decentralization of the national organization is so recent that sufficient provision has not yet been made for carrying on the work connected with the geographic sections. The New York office of the association seems to have been swamped by the rapid accessions of membership from this section. At this time we have no adequate record regarding the payment of dues. Strenuous local efforts have been made to remedy this lack of information but until we have a fuller co-ordination of effort the Pacific Coast section's progress will be hampered.

It is advisable also that greater use be made of the secretary's office as a clearing house for ideas. Each member should freely contribute results of his experience for the benefit of others and feel free to ask any questions which will be published so that others may answer them. Special facilities are available through the association for the smaller companies to secure trained men from the larger organizations. The suggestion to this end and the report of the commercial committee should greatly enhance the value of the smaller companies' membership in the association.

The work of the technical and accounting committees has been directed mainly toward standardization of practice and toward unity of action as regards regulatory requirements. This work likewise should be in constant progress throughout the year and not confined merely to convention time. It is believed that the secretary's office in this case also can be of assistance to all members.

At this time your secretary cannot forbear from expressing his appreciation for the cordial spirit of co-operation which has existed throughout the organization. It has been a constant incentive to greater activity. Our work has had a most wonderful beginning and if the large attendance at this convention, nearly a quarter of our entire membership, is any index, the future is most promising.

President Ballard: I know that you will be interested in hearing from the treasurer how much we owe. (Laughter). And at this time I will ask our treasurer to make his report, and I present Mr. A. N. Kemp of the Pacific Light & Power Corporation of Los Angeles.

Treasurer reads his report as follows:

First Report of Treasurer Pacific Coast Section National Electric Light Association

Gentlemen: At the first meeting of your executive committee, a budget for the current fiscal year was authorized in a total of $1500. This was subscribed as follows:

Salaries	$1350
Traveling expenses	600
Stationery and printing	400
General expenses	300
Postage	300
Convention expenses	250
Engineering research	500
Contingent	300
	$4000

Of the above amount up to the present time there has been expended the sum of $1118.18, distributed over:

Salaries	$400.00
Traveling expenses	486.35
Stationery and printing	220.40
General expenses	40.19
Postage	28.60
	$1,175.54
Less credit for 2 scrip books	57.36
	$1118.18

As a temporary expedient to provide funds in advance of the receipt of moneys from the treasurer of the N. E. L. A., your executive committee decided at its meeting on January 6th, that the larger Class A members be permitted to advance the aggregate amount of $1500, subdivided as follows:

Great Western Power Company	$ 168.00
Los Angeles Gas & Electric Corporation	85.00
Pacific Gas & Electric Company	530.00
Pacific Light & Power Corporation	175.00
San Diego Consolidated Gas & Electric Co	56.00
San Joaquin Light & Power Corporation	98.00
Sierra & San Francisco Power Co	72.00
Southern California Edison Co	260.00
Western States Gas & Electric Co	56.00
	$1500.00

In addition to this amount there has been received from the National Electric Light Association the sum of $2000, making a total of $3500 received, which, less the above dis-

bursements of $1118.18, leaves a cash balance in the Security Trust & Savings Bank, Los Angeles, as per the attached certificate of $2381.82.

Our proportion of the dues of the members of this section at the present time amounts to $3006.25, made up as follows:

	Number	Total Dues	Proportion to Pacific Coast Section
Class A....	51	$735.00	$ 362.50
Class B....	1237	6185.00	2171.25
Class C....	4	20.00	.....
Class D....	34	790.00	395.00
Class E....	62	310.00	77.50
	1388		$3006.25

Of this amount, as stated above, we have already received $2000 on account, leaving still due $1006.25, so that the actual cash condition to meet the requirements of the authorized budget will be:

Advanced by member companies	$1500.00
Received on account from the N. E. L. A.	2000.00
Balance due from the N. E. L. A.	1006.25
	$4506.25
Less 1917 budget	400.00
Cash balance	$ 506.25

It will be noted that the refunding of the $1500 advanced by Class A members would leave a deficit of..$ 993.75

In the event that your officers are successful in having the N. E. L. A., amend its constitution so as to permit of the remittance of 50 per cent of all Class B and E dues instead of 50 per cent for only the first 500 and 25 per cent on the remainder, our annual receipts will be increased on the basis of the present membership by $998.75 to a total of $4005.00 which is sufficient to meet the budget as set forth above.

Mr. Britton: I move you that the address of the president as read be received and referred to a committee of three for the return of such suggestions as occur to them in the re-reading of the report.

President Ballard: I will ask Vice-President Jackson to handle that motion.

(Vice-President Jackson thereupon puts the motion which has been seconded, and the motion is carried).

President Ballard: Our next order of business is the report of the membership committee. We had expected that Mr. W. W. Briggs of San Francisco, chairman of the committee, would be with us today, but he has been unavoidably detained. I will ask Mr. Kahn of Stockton, a member of this committee, to read the report of the membership committee.

Report of the Membership Committee, N.E.L.A.

Mr. R. H. Ballard, President Pacific Coast Section, N.E.L.A., Los Angeles, Cal.

Dear Sir: I am presenting herewith the report of the Membership Committee appointed to take care of development work for the increase of membership in the Pacific Coast Section of the National Electric Light Association. This committee is composed of the following gentlemen:

W. W. Briggs, Chairman, Gt. Western Power Co., San Francisco.
C. A. Luckenbach, Los Angeles Gas & Elec. Co., Los Angeles, Cal.
Samuel Kahn, Western States Gas & Elec. Co., Stockton, Cal.
L. F. Galbraith, Pacific Gas & Electric Co., San Francisco.
W. L. McKinley, Sierra & S. F. Power Co., San Francisco.
W. S. Coleman, Pacific Gas & Electric Co., San Francisco.
S. J. Lisberger, Pacific Gas & Electric Co., San Francisco.
W. F. Frost, Southern Cal. Edison Co., Los Angeles, Cal.
E. A. Quinn, San Joaquin Light & Power Co., Fresno, Cal.
Frank R. Russell, Tucson Gas & Elec. Lt. & P. Co., Tucson, Ariz.
J. B. Mechling, Nevada-California Pr. Co., Goldfield, Nevada.
Jas. A. Shepard, Deming Ice & Elec. Co., Deming, N. M.
R. C. Lane, Upper Verde Public Utilities Co., Clarkdale, Ariz.
Ross B. Mateer, Southern Sierra Power Co., Riverside, Cal.
B. G. McBride, Elko-Lamoille Power Co., Elko, Nevada.
R. S. Arthur, Douglas Traction & Light Co., Douglas, Ariz.
R. S. Masson, The Arizona Power Co., Los Angeles and Prescott.
R. E. Fisher, Pacific Gas & Electric Co., San Francisco.
Geo. B. Furness, Pacific Gas & Electric Co., San Francisco.

Your committee has received excellent assistance and cooperation from Mr. A. H. Halloran, secretary, Pacific Coast Section.

Owing to the fact that the committee had to be organized primarily by correspondence and that considerable delay was experienced in acquiring information as to the existing membership of the National Electric Light Association, in the different membership classifications, a large amount of valuable time was lost in getting our work under way.

We took up with the eastern office the question of getting literature, etc., to use in connection with the campaign for new members—particularly in Class B, but found that there was little or no material of this kind available. For that reason, Mr. Halloran, secretary of the Pacific Coast Section, produced a little folder which we provided the various committeemen and which explained the object of the association, the benefits that accrued to individual membership, etc. This folder was placed in circulation through the various committeemen, and I think I may safely state it has been productive of great benefits.

Practically all of the new applications that have been received have been forwarded to Mr. A. H. Halloran, the secretary, and there has not been sufficient time to completely check these with the older lists, which have just been received, to enable us to advise you definitely of the number of applications for membership which have been received. Then again, through a misunderstanding, some of the applications were forwarded direct to the New York office by our committeemen without being sent to Mr. Halloran, which has also caused some confusion in our records.

We are now negotiating with two sizeable companies for Class A membership, namely, the Vallejo Electric Light & Power Company, and the California Telephone & Light Company, who have not as yet, however, definitely forwarded their applications, although they are giving the matter serious consideration.

With the advent of these two latter companies into the Pacific Coast Section, I believe that we will have in our membership practically 100 per cent of the possible Class A members who derive some material benefit from the association. We are circularizing all of the smaller companies, asking them to join, but it is questionable whether those companies furnishing service in towns of a population less than 1500 would receive sufficient benefits from the association to make their candidacy worth the expenditure of much effort to secure.

The membership committee will continue its activities until such time as the incoming administration shall advise of the appointment of new committees, at which time we will be glad to forward to the new membership committee the files of correspondence which we have accumulated and which will be of assistance to them in carrying on this work.

Very truly yours,

W. W. BRIGGS,
Chairman Membership Committee.

President Ballard: Gentlemen, at this time I desire to appoint a committee on resolutions to report at the close of the business section tomorrow afternoon. There will be a number of resolutions which will be prepared for this convention to consider. As such committee I will appoint Mr. J. J. Scrugham of Reno, Nevada, W. P. Southard of Albuquerque, New Mexico, A. Emory Wishon of Fresno, California.

In connection with the program I wish to ask that all delegates and guests will thoroughly consider and appreciate the entertainment fixed for Saturday, and not be in a hurry to run home. The Saturday entertainment is going to be something very much worth while. It is being put on by the Southern Sierras Power Company, and a large part of the expense of entertainment is being paid by that company, I understand that Mr. West will be pleased if he has a large crowd to handle, and more pleased with a large crowd than with a small one.

We have with us a man of national importance on whom I shall call at this time for a few brief remarks. I refer to Mr. Muldaur, assistant secretary of the association at New York.

Mr. Muldaur: Mr. Chairman, and gentlemen of the Pacific Coast Section of the National Electric Light Association, your program is very full. Your time is brief. I have reduced to writing the few words that I have the privilege of saying to you.

Mr. President and Gentlemen of the Pacific Coast Section National Electric Light Association:

Your program is very full and your time limited. I have therefore arranged what I shall have the pleasure of saying to you, in a form that will have at least the merit of brevity.

First, and most important, it is my very agreeable duty to bring you the greetings and best wishes of the National Electric Light Association. President Wagner has instructed me to extend to you his deep regret at his inability to attend this convention in person, and his best wishes for a most successful meeting. He writes, further: "It is the desire of our administration, as representing the National Electric Light Association, to co-operate, as fully as possible, with other associations in the solution of problems affecting the electrical industry, and in all matters which we may have in common, and upon which for the benefit of the industry as a whole, we should be in accord."

The attitude of the national body, in its relations with other associations, is most concisely expressed in this message. The geographic sections perform a service to the electrical industry quite distinct from that of the national association; more intensive, more intimate in its character, and it goes without saying, that the splendid work accompliished by your members, even during the very short time your association has been in existence, is exceeded in value by none of your sister organizations:

While the geographic sections are performing this excellent work, it will not be forgotten that the national body exists for the purpose of bringing it all together in such manner that the accumulated experience of the entire country is instantly available to all its members. It is no small thing, that a problem arising on one coast may be identical with one already solved on the other, and that this fact may be learned by application to the New York headquarters. It it undoubtedly true that, as your secretary has pointed out, the membership of the association has increased out of proportion to the headquarters staff. For this reason, it is doubtless the case that desired information has not always been furnished as promptly as we could wish. It is also true, however, that this difficulty is rapidly being corrected, and I venture to say that there is not a question that can arise, from the most trivial to the highest technical application, that the national association, through its archives or its members, cannot answer. But it is essential that members should know and realize that this store-house is open to them, and should avail themselves of its contents. If the geographic organization is intensive, the national is extensive.

The National Electric Light Association takes the greatest pride in such success as yours, and appreciates to the full your loyal co-operation. It is its constant endeavor to increase the already close relations existing among the affiliated organizations, and in this it depends upon, and counts upon, your help.

Vice-President Jackson: I desire to announce the committee covered by the resolution presented by Mr. John A. Britton on the president's address. The committee will be Mr. T. E. Bibbons, chairman; Mr. Ed. Whaley and Mr. A. B. West.

President Ballard: We have now finished the schedule set for 10:30. We will now proceed with the balance of the program.

During the three or three and a half months of our existence we have had a number of committees working and working hard in preparation of papers and in making studies of the several subjects which will be discussed at the convention. It is my purpose that immediately following the presentation of a report of a committee by its chairmau that the chairman of the committee shall preside over the meeting while the discussion is taking place and while the papers relating to his committee work are being presented.

Our first session will be the commercial session, which committee has been exceedingly active under the chairmanship of Mr. Stanley V. Walton of San Francisco, and I take great pleasure at this time in presenting to you Mr. Walton, who will present his report and be in charge of the meeting for the balance of the afternoon.

Mr. Britton: Before Mr. Walton takes charge of the meeting, I would request that the senior representative of every committee wait until after adjournment to discuss with me as chairman of the public policy committee a matter of vital interest, concerning which we must decide upon some policy before the end of the day.

ANNOUNCEMENT OF THE PIT RIVER DEVELOPMENT

Development of its water rights on the Pit River, in Shasta County, recently begun by the Pacific Gas & Electric Company, will enable the company to generate 180,000 horsepower of electrical energy, more than the combined capacity of its eleven power plants, which now generate 156,000 horsepower of electric energy.

The project will be completed in five years, at a cost of $17,500,000, and involves the diversion of the water of the Pit River at the Big Bend site, sixty miles northeast of Redding. From that point water will be conveyed through seven miles of tunnel and three quarters of a mile of open ditch to a site selected for the power house. The fall of water between the point of diversion and the point of use is 939 ft. With an average stream flow of 2400 cubic feet a second, development of a minimum of 180,000 horsepower will be possible.

The Pacific Gas & Electric Company purchased its water rights from the Mount Shasta Power Corporation, which began to develop the project in 1906. The water site is considered very good, because, from a drainage area of 4365 square miles, a constant process of underground water storage, due to lava formation, makes the supply vary little with the seasons. The State Water Commission in 1912 reported that 412,000 horsepower could be developed along the Pit River without storage.

From the power house in Shasta County the electricity will be transmitted by steel tower line across country to tie in with the company's other high tension lines to San Francisco bay. The current will be carried along the wires at a voltage of not less than 110,000.

Discussing the construction of the new plant and the development of the Pit River power, General Manager John A. Britton said recently:

"We calculate that this expenditure and its result will take care of our company's needs for from ten to fifteen years, at the present rate of our growth. The industrial feature of California's development is assuming larger proportions every day. This condition has been brought about by cheap electric power.

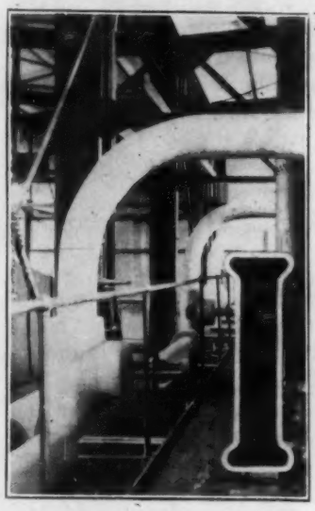
"The word has gone forth that every possible acre of land in California is to be made use of to meet the food situation, and here, too, electricity comes into play."

FUEL OIL AND STEAM ENGINEERING

(The different uses of wet saturated steam, dry saturated steam and steam that is superheated call for some standard to which boiler performance may be properly referred for comparative tests and performances. Equivalent evaporation and factor of evaporation are necessary working tools to accomplish this result. In this article the author first defines these quantities and then proceeds to methods of computing them for the three qualities of steam referred to. He then concludes with an example of how to compute the boiler horsepower when these factors are known.—The Editor.)

EQUIVALENT EVAPORATION AND FACTOR OF EVAPORATION IN FUEL OIL PRACTICE

BY ROBERT SIBLEY



Piping in Boiler Setting where Superheat Temperatures are Taken

IN the previous chapter it was seen that as the fundamental definition of the boiler horsepower is based upon a fictitious boiler that receives its feed water at 212° F. and then evaporates it into dry saturated steam at 212° F. and atmospheric pressure, we must now develop some factor by which we can reduce boiler performances as actually met with in practice to this fictitious standard.

In order also to compare the steaming qualities of two different boilers or indeed to compare the same boiler under different conditions of water supply and steam generation, it is necessary that some standard of comparison be adopted. Thus a boiler under its normal condition of operation may be found to evaporate 1361 lb. of water per lb. of oil fired per hour when taking its feed water at 169.1° F. and converting it into superheated steam at a temperature of 527° F. and a pressure of 185.3 gauge. On the other hand, the identical boiler, when steaming under overload conditions of a feed-water temperature of 174.1° F., a superheat temperature of 536.9° F. and gauge pressure of 194.1 lb. per square inch may be found to evaporate only 13.17 lb. of water per lb. of oil fired, even though the same quality of oil be used in each instance. It is evident then from sight that to compare these two evaporative quantities without taking account of the actual heat transferred from the fuel to the steam in the boiler would be a possible source of error.

The Standard that Has Been Adopted.—To avoid inconsistencies and to develop some rational method of comparison, engineers have found it convenient and accurate to reduce all evaporative quantities of a boiler to a definite standard. In order to follow out this standardized comparison, all steam generating performances of boilers read as if the boiler took its feed water at 212° F. and atmospheric pressure, and converted it into dry saturated steam at 212° F. and atmospheric pressure, as set forth in the standard definition of the boiler horsepower in the last chapter. It is clearly evident that no such theoretical boiler has ever existed, yet this standard of comparison is found very convenient. Thus in any case of boiler performance, if M_e represents such an equivalent or comparative standardized evaporation in lbs. of water per lb. of fuel, and M_w the lb. of water actually evaporated in the boiler under conditions of test, we may now invent a factor to be known as the factor of evaporation, F_e, whereby such performances may be readily reduced:

$$M_e = M_w . F_e \quad \ldots\ldots (1)$$

In the same way, the equivalent evaporation of water per hour may be computed from the formula

$$M_{eh} = M_{wh} . F_e \quad \ldots\ldots (2)$$

wherein M_{eh} and M_{wh} represent hourly conditions of evaporation.

Let us next analyze the factor of evaporation and see how we may actually compute its value for any given case. We have previously found that in the operation of the boiler, steam appears in three different conditions or qualities, namely in what is known as dry saturated, wet saturated, or super-heated steam. Let us then consider the evaluation of the factor of evaporation for these three distinct instances.

Dry Saturated Steam.—In the case of dry saturated steam, the water enters the boiler already possessing a heat of liquid h_f corresponding to its entrance temperature which may be readily found in the steam tables. This water is next converted into dry saturated steam which has a total heat (H_e) corresponding to the pressure at which the evaporation takes place. Consequently the actual heat which has been transferred from the boiler shell to the water is ($H_e - h_f$) heat units. But to evaporate one pound of water at 212° F. into dry steam at 212° F. requires 970.4 heat units. Hence if M_w pounds of water are evaporated under test conditions, the number of pounds M_e under standardized conditions would evidently be $M_w \frac{(H_e - h_f)}{970.4}$. Therefore, for dry saturated steam

$$F_e \text{ (dry saturated steam)} = \frac{(H_e - h_f)}{970.4} \quad \ldots\ldots (3)$$

Thus in the case of a boiler which takes its feed water at 101.8° and converts it into dry saturated steam at 180 lb. pressure per square inch, from the steam tables we find that H_e is 1196.4 and h_f is 69.8, hence the factor of evaporation is

$$F_e = \frac{1196.4 - 69.8}{970.4} = 1.16$$

Wet Saturated Steam.—In the case of wet saturated steam all of the water entering the boiler is not converted into steam. As a consequence a certain portion of heat $(h_e - h_f)$ is required to raise the temperature of the water from entrance temperature t_f to the temperature of evaporation t_e and if only x_e parts of a lb. are then evaporated into steam, only XL_e B.t.u. are required to accomplish this result. Hence, the total heat required per lb. of water so evaporated is $(h_e + X_e L_e - h_f)$.

As a consequence the factor of evaporation in this case may from similar reasoning be expressed by the formula (wet saturated steam)

$$F_e = \frac{(h_e + X_e L_e - h_f)}{970.4} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

As an instance showing the application of this formula let us assume that the boiler above mentioned did not evaporate the water into dry steam but that upon investigation it was found to contain 5 per cent moisture. What now is its factor of evaporation? From the steam tables we find that h_e is 345.6, L_e is 850.8 and h_f is 69.8. Therefore the factor of evaporation is

$$F_e = \frac{345.6 + .95 \times 850.8}{970.4} = 1.117$$

Superheated Steam.—In the third instance steam is not only evaporated to a dry saturated condition, but is finally sent from the boiler in a superheated condition. The steam tables are so arranged that we may find the heat necessary to raise the total heat of superheated steam when its pressure and temperature are known. Considering that the water entered the boiler at 32° F., let us then call H_s the total heat of superheated steam. Since now the water entered the boiler with a heat of liquid equal to h_f the actual heat entering each lb. of steam evaporated in the boiler under these conditions is $(H_s - h_f)$ heat units. Hence in this instance the factor of evaporation is likewise from similar reasoning computed by the formula: (superheated steam)

$$F_e = \frac{H_s - h_f}{970.4} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

To follow up the same example as set forth in the preceding illustration, let us assume that the steam is evaporated under the conditions hitherto mentioned, but that it appears superheated to the extent of 100°. Looking in the steam tables we find that the total heat H_s of superheated steam at 180 lb. pressure and 100° superheat is 1254.3 and that the heat of liquid h_f is 69.8, consequently the factor of evaporation is

$$F_e = \frac{1254.3 - 69.8}{970.4} = 1.22$$

To Compute the Boiler Horsepower.—Since now by means of formula (57), we are enabled to compute the equivalent evaporation M_{wh} in pounds of water per hour that the boiler under test would evaporate were it taking its feed water at 212° F. and converting it into dry saturated steam at the same temperature, we can at once compute the horsepower of the boiler. Under such conditions of operation for every 34.5 lb. of water evaporated per hour, the boiler is developing one boiler horsepower. Hence to compute the boiler horsepower, we write the formula:

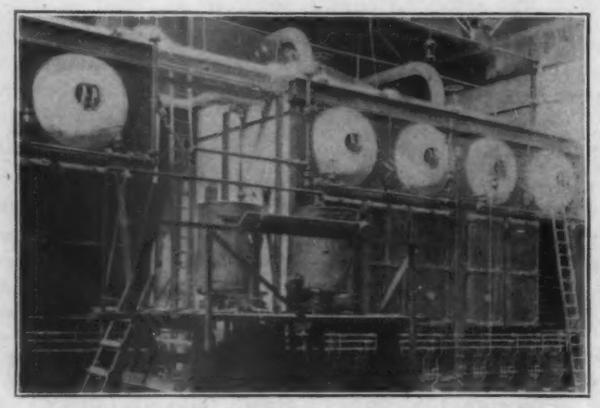
$$\text{Bl. hp.} = \frac{M_{wh}}{34.5} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Thus if a boiler has an equivalent evaporation of 23,350 lb. of water per hour, its horsepower is found to be

$$\text{Bl.h.p.} = \frac{23{,}350}{34.5} = 676.7$$

We could of course develop an expression for the computation of boiler horsepower by taking into consideration the heat absorbed by the generation of steam per hour. For in our discussion in the previous chapter it was shown that one boiler horsepower is equivalent to the absorption of 33,479 heat units per hour. Hence, by computing the heat absorbed by the total pounds of steam generated per hour and dividing this by 33,479, we can compute boiler horsepower and arrive at the same answer as given in the above formula. It is better, however, for the beginner to follow fundamental definitions rather than attempt too many short cuts to gain quick results.

In conclusion the important relationship to bear in mind is the vast difference between the socalled mechanical horsepower and the boiler horsepower which was brought out in the previous discussion. With this relationship firmly fixed it must be remembered that equivalent evaporation is such an evaporation as would be brought about by taking in water into the boilers at 212° F. and evaporating it into dry saturated steam at 212° F. and atmospheric pressure. The formulas deduced above for equivalent evaporation and factor of evaporation enable us to do this.



Platform Scales and Tanks for Water Measurement

The boiler immediately to the right of the platform scales is under test. The tank below the platform scales into which the water is emptied after being weighed, is utilized to furnish all water for the boiler during the test. At the beginning of the test a hooked gauge registers the height of the water in this tank, and at each hourly period thereafter sufficient water is weighed and emptied into it from the tanks above to maintain this exact level. By means of these data, properly taken, the factor of evaporation and the boiler horsepower are easily computed.

SPARKS—Current Facts, Figures and Fancy

(The recent trend of events has necessitated the deepest thought and attention of utility companies throughout the West looking toward forwarding the production of agriculture and the consequent increased use of electrical energy. Below will be found an interesting and profitable item on how potatoes are preserved over long periods of time in Bolivia that might receive application in sections of the West. Other items that may serve in giving you a new thought or further inspiration for work may be gleaned from the following notations.—The Editor.)

Balsa wood, found in Central America, is said to be the lightest known wood. It is lighter than cork and has an average specific gravity of only .104.

* * *

A wood specimen found in glacial drift and estimated by the Wisconsin State Geologist to be approximately half a million years old has been identified by the Forest Products Laboratory of the Forest Service as spruce.

* * *

Nearly forty billion feet of timber was cut in 1916 in the United States. The State of Washington was again the largest producer with four and one-half billion feet, Louisiana being second with about four billion and a quarter feet.

* * *

It was the unanimous opinion of the National Chamber Committee which met in Washington recently that employers should await the result of legislation now pending in congress before making arrangements for the dependents of employes who enlist.

* * *

More than twenty million dollars will probably be spent in the next ten years in building good roads in the National Forests. What this will mean to the farmers and settlers living in and near the Forests and to the vast number of other Americans who may wish to use them as places in which to find health, rest, and recreation can scarcely be realized.

* * *

A new step in railroad service has been taken by the Southern Pacific Company in the establishment in the larger cities along the coast of a ticket delivery system. Hereafter, the busy housewife or the harassed man of affairs can telephone for tickets, Pullman reservations or scrip books, and have them delivered to home or office by special messenger.

* * *

An electric tractor, believed to be the first in California, built by the Agricultural Engineering Division of the University of California, was exhibited on Picnic Day, Saturday, April 28, at the University Farm at Davis. This electric tractor, which has proved very satisfactory in the preliminary trials, is not meant for heavy work, but to replace hand labor. While still in the developmental stage, it has proved that it can be run economically.

* * *

There is a great industrial awakening in Russia in the building of railways. The contemplated railway connection between India and Europe through the Hindu Kush will make the mail time between London and Delhi six days instead of the seventeen days required by the sea route via the Suez Canal. The cost of the passenger trip by railroad to India would probably be only about half as great as by the present roundabout steamship service.

* * *

New studies are constantly necessary for the engineer intending to engage in foreign service. For instance in the purchase of machinery intended for use in Oriental countries such as the Port of Aden and vicinity an important consideration is the quantity of gritty dust or sand which the strong winds prevailing at certain seasons of the year carry on and into everything. All machinery for this market should be as nearly dust or sand proof as possible. Further, the climate of Aden quickly affects all metal parts susceptible to rust, unless protected with particular care

* * *

In order to re-establish confidence in advertising the following are some violations in the new standard of ethics throughout the West: Questionable stock and bond issues, especially those from other states which get by the state commission on technicalities; unwarranted promises in land development; offers of something for nothing; misleading "help wanted" cards; "blind" classified advertisements; exaggerated untruthful statements; alleged "fire" and "bankruptcy" sales; patent medicine fakers; so-called painless dentists; Chinese doctors; men's diseases specialists.

* * *

Potatoes are cultivated throughout the Andean plateau in Bolivia at altitudes where even the hardiest grains and vegetables find life impossible. The natives have a method of preparing the potato so that it resists decomposition over long periods of time. By alternately freezing and thawing the tuber all the moisture is removed, and the resulting "chunu" (dried potato) can be stored for many months and even years without fear of its deteriorating. Pressed into little bullet-shaped units, "chunu" is on sale in every market on the Andean plateau and is a most important source of nourishment for the Indians.

* * *

The provincial government of Ontario, contemplates placing tractors at the disposal of farmers as a means of greater production. The government has about 35 district representatives in the more important agricultural counties of the province, and apparently intends to place a tractor at the disposal of each of these representatives, to be used in assisting the farmer to plow and prepare his land for the planting of crops. It is proposed to make a nominal charge per day or per acre and to keep the tractors going day and night. This is a suggestion that certain central stations of the West might perhaps note with profit.

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CONTENTS

The Electric Flag and the Novagem 377
Proposed New Illumination Effects. *By W. D'A. Ryan* 378
Economizing Devices in a Small Hydraulic System. *By J. W. Swaren* 379
The Jobber: Is He a Nuisance or a Necessity? *By A. T. Slack* 381
The Disaster at the Mountain King Mine 384
Letter to the Editor on The National Crisis. *By Gifford Pinchot* 384
Hyperbolic Solution for Engineering Problems. *By W. D. Peaslee* 385
The Problems of Water Requirements. *By Fred F. Henshaw.* 388
Our Preparedness for Foreign Trade 389
What Exposure Shall I Give? *By C. B. Merrick* 390
Demand Meters of Time Lag Type. *By W. A. Hillebrand* .. 391
Little Journeys in Pacific Lands. *By J. W. Finch* 393
Unlined Earth Reservoirs for Pumping Plants. *By S. T. Harding* 395
Suggestions for Off-Peak Hours—I 397
Helping the Electrical Dealer to Help Himself and Other Discussions of Interest to Contractor and Dealer. *By George A. Schneider* 398
Pacific Coast Section N. E. L. A. Jottings 400
Equivalent Evaporation and Factor of Evaporation in Fuel Oil Practice. *By Robert Sibley* 405
Sparks—Current Facts, Figures and Fancy 407
Editorials 408
- The N. E. L. A. Meeting in New York City.
- A New Means of Reaching the Investing Public.
- A Significant Announcement.
- An Opportunity for Effective Service.
- National Efficiency and the New Patriotism.

Personals 410
Meeting Notices for Electrical Men 411
Utility Co-operation. *By Ed Whaley* 412
A Tribute from the Contractor Dealer on the Riverside Convention. *By C. F. Butte* 413
Lecture Course for Engineer Officers' Reserve Corps 413
Technical Men Wanted 413
Book Review 416
New Bulletins 416
Latest in Everything Electrical 414
What Western Inventors Are Doing 417
New Electrical Developments 418

THE TRIUMPH OF RIGHT

"But the right is more precious than peace, and we shall fight for the things which we have always carried nearest our hearts—for democracy, for the right of those who submit to authority to have a voice in their own governments, for the rights and liberties of small nations, for a universal dominion of right by such a concert of free peoples as shall bring peace and safety to all nations, and make the world itself at last free."

The N. E. L. A. Meeting in New York City

Electrical men of the West feel gratified to hear that their eastern brothers in the National Electric Light Association have held during the past week such a profitable meeting at New York City. Considerable dismay was at first felt throughout various sections of the West, after such a beautiful and enthusiastic meeting as that at Riverside, when the news came concerning the proposed abandonment of the annual convention of that organization at Atlantic City.

Later information developed the real reason for this abandonment to be due to the fact that the various member companies desired their men close at home during the present strenuous times. As these editorial sheets go to press the news that reaches us from New York City tells of the wonderfully effective work of the meeting held there during the past week. The remarkable patriotic fervor that was exhibited by the leaders of the electrical industry throughout the intensive section meetings that were held is a source of inspiration to the electrical industry the country over.

A New Means of Reaching the Investing Public

The present international crisis has not only brought out the fact that hydroelectric securities are to be considered of very desirable preference due to their ready acceptance as collateral for international financing, but the means that such organizations offer in reaching the investing public is another interesting and commendable feature of recent development.

One large hydroelectric company in the West has found a most convenient method of disposing of certain of its stocks and bonds on a very decidedly extended scale by dealing directly with its quarter of a million consumers through its own customers' mailing lists without the usual assistance of the bond broker. This has been proven so eminently satisfactory that Secretary McAdoo has had his attention called to it as a possibility of reaching with ease a most desirable class of the investing public for purchase of the present two billion dollar Liberty bond issue now being floated by the national government. This move on the part of public utilities of the West is not only a most patriotic and commendable one, but it shows, too, the helpful interrelationship that the modern utility company bears to the very heart throbs of the nation.

A Significant Announcement

The announcement by the Pacific Gas and Electric Company of its proposed new development of 180,000 horsepower of hydroelectric energy at the Big Bend site along the Pit River in Northern California will have a most marked effect in stabilizing national defense in so far as the Pacific Coast is concerned. Situated in a region of intense mineral wealth, generating in synchronism with its present eleven hydroelectric plants, this new project will add vastly to the present possibilities of munition and nitrate manufacturies in addition to providing an additional supply of energy for the future industrial and agricultural growth of the State.

As summarized elsewhere in this issue the new project will more than double the present installed hydroelectric output of this great high-tension distribution system, already the largest of its kind in the world.

The drainage area from which the Pit River draws its supply comprises 4365 square miles and is remarkable for its ability in equating the runoff throughout the different seasons of the year so that a minimum flow of 2400 cubic feet per second may be conservatively counted upon. By means of a seven-mile tunnel the water may be dropped 939 feet, thus developing the 180,000 horsepower above alluded to.

The investment of $17,500,000 required for this installation during the next five years will not only of itself materially forward financial and industrial activity throughout the West, but the new dollars set rolling in countless allied industries can hardly be overestimated.

An Opportnnity For Effective Service

To every thoughtful man there comes the question at this critical period, "What can I do personally to aid the national government or what influence for effective service can I exert at this present time for harmonious and unified action over business affairs under my personal control?"

To the man interested in hydroelectric activity this appeal comes with unusual emphasis. Upon the continuous operation and unhampered development of the great water powers of the West depend much for the operation of the industries, the mining of much needed metals, the production of agricultural products and the consequent safety of the nation.

At the recent Riverside convention of the Pacific Coast Section of the National Electric Light Association, the representatives of forty great central stations of the West, comprising an investment of a half billion dollars, unanimously offered service and system to the government to meet the exigencies of the present crisis.

The time is now ripe to make this beautiful offering of real concrete service to the nation. Let a movement be started at once to catalogue with definiteness the combined effectiveness this gift offers to the nation. Let their chemists report on the feasibility of nitrate manufacturies in various localities of the West. Let their electrical engineers advise as to proper proportionment of power for such nitrate and munition plants. Let the banker and financier be invited in to assist in securing additional funds for the immediate construction of such plants as may be reasonably built for manufacturing munitions and implements of war. Let the railway chiefs give of their experience and recommend ideas for improved traffic conditions, and finally let the agriculturist be called in to harmonize with such enlarged work in order to make the hydroelectric activities of the West of untold service to the nation and contribute their share to the war for world-wide democracy.

The tremendous advantage to the West of such industries immediately upon conclusion of the war in developing gigantic engineering trade relations with South America, Central America, Australia, China and Russia cannot be overestimated. But best of all for real concrete assistance to the government in the present state of affairs, no more beautiful and effective patriotic move could be made.

National Efficiency and the New Patriotism

The application of engineering efficiency study to the analysis of national effort brings to light many conclusions of utmost importance for the solution of the gigantic present-day problems immediately ahead of the nation.

The world conflict now upon us is admittedly one that will ultimately be decided by brains rather than brawn. All authorities agree that an appeal to the emotions solely is not sufficient to solve a weighty problem in analysis. To enter into the attempt to solve such a problem with enthusiasm aids much, but the all-conquering element of quiet, thoughtful reflection is the force that eventually carries the solution to a logical conclusion.

To properly and efficiently harness the working force of this nation will require the intelligent thought of every citizen—big and small, rich and poor—each synchronously performing the task to which he is best suited.

To send a volunteer force to Europe under the "hurrah and throwing of the hat enthusiasm" led by one of the greatest figures in modern public life of America would undoubtedly kindle a glow of patriotic fervor seldom realized in national life.

It would seem, however, that the advisability of this sending of volunteer troops to foreign lands as opposed to the selective idea should be weighed solely on its merits as to what best harmonizes with uniform activity of national strength. The old idea of volunteer and conscript has passed. A new patriotism is upon us. Ask any man in the street and you will fail to find any one but that is willing to make the sacrifice whatever that sacrifice may be, provided it is shown that the duty assigned him will bring about the most effective results for the nation as a whole.

And above all, efficiency study has taught us that the subjugation of selfish desire to the national good is the most effective way to produce results. In the present crisis there is no place for the big "I" of personal ambition. That which goes toward promoting the common welfare of the nation as a whole and mankind, in general, are the only considerations that should enter. This evident fervent spirit of patriotism manifested on all sides awaits but the selective call to the service required and the answer will be quick and effective. Such are the salient features of modern evolution in national efficiency and the new patriotism.

PERSONALS

W. F. Durand, professor of mechanical engineering at Leland Stanford Junior University, has been called to Washington to assist in advising the national government on the subject of aeronautics. Professor Durand has long been recognized as an eminent authority on many phases of mechanical engineering and this splendid possibility of effective contribution in the way of governmental engineering assistance comes as no surprise to close followers of his activities. The best wishes of engineers of the West go with him and they wish him god-speed in his new undertaking.

W. A. Thompson, general agent Federal Sign System (Electric) is at San Francisco from Boise, Idaho.

S. M. Kennedy, general agent of the Southern California Edison Company, is a recent San Francisco visitor.

T. W. Simpson, manager of the Federal Sign System (Electric) at San Francisco, spent the past week at Carmel, Cal.

C. E. Heise, manager of the Westinghouse Electric & Manufacturing Company at San Francisco, has returned from a trip to Honolulu.

H. W. Dryden, construction engineer in foreign department of General Electric Company, was at San Francisco during the past week on his way to Schenectady from India.

Arthur L. McLeod, manager of the Jeffery-Dewitt Company of Detroit, is a recent San Francisco visitor on his way East from a visit to many of the larger power companies of the Pacific Coast.

A. Emory Wishon, assistant general manager of the San Joaquin Light & Power Company, was a recent guest at the luncheon of the San Francisco Electrical Development & Jovian League at the Palace Hotel.

Max Loewenthal, general manager of the United Trading Company of San Francisco, has returned from a trip covering the coast territory, in the interest of the various firms which his company represents on the Pacific Coast.

H. B. Lane, formerly with the General Electric Company at Schenectady, has left for Shanghai, China, to be associated with Anderson, Meyer & Co., Ltd., in the capacity of commercial engineer. This company has the agency for the General Electric Company for the Republic of China.

A. H. Babcock, consulting electrical engineer Southern Pacific Company; **W. A. Cattell,** consulting civil engineer at San Francisco, and **D. P. Fullerton,** general superintendent Pacific Telephone & Telegraph Company, have received commissions as majors in the engineer officers' reserve corps.

Tracy Bibbins of the Pacific States Electric Company, **Samuel Taylor** of the Electric Railway Manufacturers' Supply Company, and **Albert Elliot,** secretary for the Pacific Coast Electrical Supply Jobbers' Association, have left for Hot Springs, Va., where they will attend the national convention of the Electrical Supply Jobbers' Association.

W. D'A. Ryan, the noted illumination engineer of the Panama-Pacific Exposition and of the Path of Gold in San Francisco, was recently presented with a beautiful loving cup through the San Francisco Call at the Downtown Association in the Colonial room of the St. Francis Hotel in appreciation of his wonderful contributions to the civic life of San Francisco.

Chas. J. Derleth, dean of the college of civil engineering at the University of California, will again resume his activities at the university with its opening of the Fall semester in August. Mr. Derleth, after a year's leave of absence from actual business life is feeling again his former grasp on life and is looking forward to the opening of college with much anticipation.

S. V. Mooney is president and treasurer, **B. L. Hodghead** vice-president, **K. G. Roebling** secretary, **I. J. Francis** general Coast sales agent, **S. W. Gilman** assistant secretary and manager San Francisco store, **J. N. Colkitt** manager Los Angeles store, **L. H. Parker** manager Portland store and **W. F. Richardson** manager Seattle store of the John A. Roebling's Sons Company of California.

George A. Schneider, power apparatus specialist for the Western Electric Company at San Francisco and a well-known departmental contributor to the columns of the Journal of Electricity, recently addressed members of the electrical club of the Oakland Chamber of Commerce on safeguarding the electrical worker in the discharge of his duty. In his address Mr. Schneider gave an outline of the safety devices which the law demands for the protection of electrical workers and the reasons which caused the enactments.

W. D. A. Peaslee, professor in electrical engineering at the Oregon Agricultural College, Corvallis, Ore.; **John Harisberger,** general superintendent light and power department Puget Sound Traction, Light & Power Company at Seattle; **A. R. Haynes,** chief operator White River generating station P. S. T., L. & P. Company, Dieringer, Wash.; **J. W. Swaren** of the Pelton Water Wheel Company at San Francisco, and **J. M. Morris** of the Westinghouse Electric & Manufacturing Company at Los Angeles, have received commissions as captains in the engineer officers' reserve corps and are now at the Presidio, San Francisco.

Chenry C. Bartlett, superintendent Corona Gas & Electric Company, Corona, Cal.; **Chas. H. Lee,** consulting civil engineer at Los Angeles; **Leslie W. Nims,** chief operator Utah Light & Traction Company, Salt Lake City, and **J. P. Growdon,** engineering department Northwestern Electric Company at Portland, have been commissioned as first lieutenants in the engineer officers' reserve corps and are now at the Presidio, San Francisco; **E. R. Perry,** commercial engineer Puget Sound Traction, Light & Power Company, Seattle, and **R. F. Dean** of the Pacific Power & Light Company at Pomeroy, Wash., are among the second lieutenants commissioned.

C. R. Young has been appointed sales manager of the Pacific Power & Light Company. Mr. Young has been with the Pacific company since 1911, acting in various capacities in the purchasing, operating and sales departments. He has also spent some time in the field. During the recent reorganization, at which time **Lewis A. McArthur** was made general manager, Mr. Young assumed the duties of sales manager but did not receive his actual appointment until a few days ago when public notice was sent out by the company. His headquarters are in the Spalding Building, Portland, Oregon. Mr. Young is a native of Eureka, Cal., and a graduate of Stanford University.

H. F. Jackson, president of the Sierra & San Francisco Power Company, and **J. E. Woodbridge,** resident engineer of Ford, Bacon & Davis, have returned to San Francisco from a visit through the Northwest. While at Spokane they purchased a 9000 kw. steam turbine from the Washington Water Power Company for installation in the North Beach plant of the Sierra & San Francisco Power Company. A conference was also held with representative men of the Northwest looking toward a closer co-ordination of the Northwest Electric Light and Power Association and the Pacific Coast Section, N. E. L. A.

MEETING NOTICES FOR ELECTRICAL MEN

(The most noteworthy meeting of men of the electrical industry during the past semi-monthly interval was that of the Pacific Coast Electrical Supply Jobbers' Association at Del Monte, California. The theme of discussion proved to be in the nature of an echo meeting of the Riverside convention described in the last issue of the Journal. This body of men is noted for its spirit of comradery and the good times and firm friendships formed at Del Monte have now become classic in the annals of the West. Other meetings of interest to men of the electrical industry are also described in the following pages.—The Editor.)

Pacific Coast Electrical Supply Jobbers' Association

The regular quarterly meeting of the Pacific Coast Electrical Supply Jobbers' Association was held at Del Monte, California, April 26-28, with a representative attendance of jobbers, manufacturers and central station men. Golf was, as usual, the all-absorbing avocation. The principal honors were carried off by T. E. Burger, who won the new Turner trophy for the first time and also the Pass & Seymour cup. Under the new system of handicapping on 72 par his score was 100 gross and 65 net. Ray Murphy was second with 122 gross and 70 net while C. C. Hillis, J. G. Pomeroy and E. J. Wallis tied for third place.

S. V. Walton by winning the central station cup for the third time secured it permanently with 111 gross and 71 net. The jobbers' copper cup and accompanying Del Monte trophy was won by C. C. Hillis with 88 gross and 71 net. The jobbers' cup for manufacturers' play was won by Miles F. Steel with a score of 112 gross and 70 net.

The chief topic for discussion at the general meeting on Saturday afternoon was A. W. Childs' paper on "Merchandising" as presented at the Riverside convention Pacific Coast Section N. E. L. A. A number of constructive suggestions were brought forth and should form the basis of definite action during the next few months.

Following the convention there was a district meeting of Western Electric Company managers and sales managers, including C. H. Talmage, the new manager at Salt Lake City, D. J. Butts of Los Angeles and Chas. Chestnut, the new sales manager at Seattle and Portland.

BUILDERS OF THE WEST—V

C. E. GRUNSKY

That an engineer of the West should have had a part in the building of the great Panama Canal is indeed a source of gratification to all well-wishers of the West. That noteworthy contributions to the technical press and to the transactions of distinguished engineering societies of America should be under the authorship of an engineer of the West is again in keeping with the best traditions of engineers of the West. But to C. E. Grunsky, as the courteous, hospitable leader in thought of commonwealth discussion this issue of the Journal is dedicated, since by the encouragement of such leadership the West may ultimately hope to take its place in world thought and activity.

San Francisco Electrical Development and Jovian League

Professor Ira W. Howerth, dean of the extension division of the University of California, was speaker for the noonday meeting of Wednesday, May 2, 1917. Mr. Howerth spoke in a most interesting and entertaining manner concerning the vast usefulness that this comparatively new effort to reach men of the electrical industry and other business activities of the West is accomplishing. Miles F. Steel, western manager of the Benjamin Electric Manufacturing Company, acted as chairman of the day. R. M. Alvord of the General Electric Company and president of the league, and Robert Sibley, editor of the Journal of Electricity, were presented with gold buttons for superior attendance at the league meetings.

W. W. Hanscom, a well-known consulting electrical engineer, and member of the league addressed the meeting May 9, 1917, on the subject of wireless telegraphy. Mr. Hanscom showed a wonderful grasp of his subject and described in interesting detail the modern accomplishments of this new art. Tracey W. Simpson of the Federal Sign System (Electric) acted as chairman of the day.

The Pacific Coast Gas Association

Attractive postal cards portraying the wonders of Santa Cruz are being sent out which read as follows: "Watch for announcement, Second "Get-Together" Dinner, Season 1917, Pacific Coast Gas Association, Los Angeles, Saturday, June 9, 1917. Twenty-fifth Convention, Santa Cruz, California, September 18 to 21, 1917."

The Oregon Society of Engineers

At the meeting of the Oregon Society of Engineers Saturday night, April 28, 1917, in the Oregon Building, the evening was devoted to a debate and discussion of the $6,000,000 road bond bill. O. Laurgaard presented the affirmative, while J. P. Newell gave the negative side.

Following the leaders, three minute discussions were allowed and among the speakers were E. J. Adams of the State Highway Commission, J. W. Cunningham, consulting engineer; John R. Penland, city engineer of Albany; Professor F. G. Young, head of the economics department of the University of Oregon; and J. D. Brown, president of the Farmers' Union.

The body unanimously adopted a motion authorizing President H. L. Vorse to appoint a committee of five engineers to compile statistics of the actual cost and life of different types of pavement. The committee is to co-operate with a similar committee from the Portland Realty Board.

Los Angeles Jovian Electric League

Harry N. Sessions, First Tribune of the Jovian Order, and first in the hearts of local Jovians, sustained his reputation as such at the meeting on April 25th, by putting over a splendid program, which was thoroughly enjoyed by the large number attending. Frederic T. Woodman, present mayor of Los Angeles, and candidate for re-election, was the principal speaker and talked on "Municipal Affairs." His platform and policies were outlined in a very interesting speech. Excellent entertainment features were introduced, including songs by the Lamp Socket Brigade of the Southern California Edison Company, the only quartet that carries its own scenery. Souvenirs were also distributed and a good time enjoyed by all.

The meeting of May 9th was conducted by Carl Young, second vice-president, in the absence of the president, A. E. Morphy. Harry C. Donoho, superintendent of the public employment bureau, the speaker of the day, talked on the subject of the Problem of Employment. Mr. Donoho outlined the work of the bureau, asserting that there is something decidedly wrong with the industrial organization of the country, and in a very entertaining and convincing way proved beyond a doubt the advantage to employers of using the municipal bureau in filling positions in their organizations. He stated that the Los Angeles Employment Bureau is beyond a doubt the largest organization of any private or public institution of its kind in the United States, having twenty-five clerks, three field agents, and filling forty-seven thousand positions within the last year. During the course of the program First Tribune Harry Sessions put some ginger into the proceedings with an impromptu rapid fire of witticisms and repartee which was very amusing and entertaining. W. C. Morrell of the Graham-Reynolds Electric Company, acted as chairman of the day and the music was furnished by the Cook Brothers.

Presentation of Edison Medal

The seventh Edison medal, which on December 13, 1916, was awarded to Mr. Nikola Tesla, "For meritorious achievements in his early original work in polyphase and high frequency electric currents," will be presented to Mr. Tesla at the annual meeting of the American Institute of Electrical Engineers in the Auditorium of the Engineering Societies Building, 29 West 39th street, New York, on Friday evening, May 18, 1917, at 8:30 p. m. Ladies are invited to attend this meeting. President H. W. Buck will preside, and addresses will be made by Dr. A. E. Kennelly, chairman of the Edison Medal Committee; Mr. Charles A. Terry of New York, and Mr. B. A. Behrend of Boston. The Edison medal was established upon the initiative of a group of friends and associates of Mr. Thomas A. Edison, for the purpose of recounting and celebrating the achievements of a quarter of a century in the art of electric lighting, with which the name of Edison is imperishably identified. It was decided that the most effective means of accomplishing this object would be by the establishment of a gold medal, which should, during the centuries to come, serve as an honorable incentive to scientists, engineers and artisans to maintain by their works a high standard of accomplishment. The Edison medal was, therefore, established and endowed with a trust fund, under an indenture dated February 11, 1904, whereby the American Institute of Electrical Engineers agreed to award the medal annually. The medal is awarded each year by a committee consisting of twenty-four members of the Institute, to a resident of the United States of America and its dependencies, or of the Dominion of Canada, "For Meritorious Achievement in Electrical Science or Electrical Engineering or the Electrical Arts."

UTILITY CO-OPERATION TO INCREASE PRODUCTION AND LOWER COSTS

BY ED WHALEY

(Broad gauge service to the nation is the keynote of the hour. Here is a most valuable suggestion from the newly-appointed general agent of the Northern California Power Company.—The Editor.)

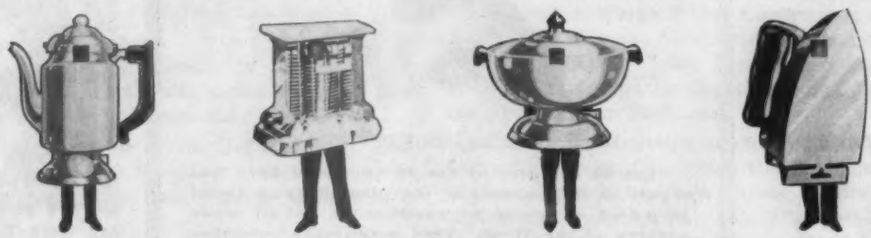
A number of the water companies of the State, with the able co-operation of the Railroad Commission, are taking steps to make their surplus water supplies available under emergency conditions for the duration of the war so that increased planting may be encouraged as an important step towards meeting a world shortage of foodstuffs. The irrigator depending upon an individual pumping plant operated either electrically or by gasoline engine can render an equal service if not a greater one as regards acreage affected by co-operating with his immediate neighbors by placing at their disposal his pumping plant for use at such times as he is not operating it, the operating costs, of course, to be divided between the users in proportion to the hours of use made by each.

Based on a six months irrigation season the average pumping plant in Northern California operates only about 15 per cent of the time. This would indicate that approximately six times the present acreage could be irrigated from these plants merely by an extension of ditches and a proper arrangement of crops. Practically, of course, such a result could not be expected as ample allowance would have to be made for additional seepage losses, character of crops, etc., but it is safe to say that by effective co-operation present installations could be made to serve 100 to 150 per cent additional land.

In the case of electrically operated plants operating under any block schedule of rates the additional hours of operation would bring the additional service under one of the lower steps of the rate so that the acreage cost per kilowatt hour and the power cost per acre irrigated would both be very materially lowered.

From an economic standpoint such action would be desirable at any time but it would be particularly advantageous in the present emergency because immediate results can be obtained, production can be increased and production costs automatically decreased, no additional investment is required and the details can be quickly worked out between each man and his neighbor where friendly intercourse and mutual helpfulness already exists.

A feature of the banquet at the Riverside convention of the Pacific Coast Section N. E. L. A. was the Lamp Socket Quartette, a clever conception by Walter L. Frost, assistant to the general agent of the Southern California Edison Company. The quartette was composed of H. S. Ross, M. MacNeil, C. H. Bishop, G. E. Armstrong and accompanied at the piano by Walter A. Linsdell. The singers



The Lamp Socket Quartette

Mr. Ross as "Percolator"; Mr. Armstrong as "Toaster"; Mr. Bishop as "Chafing Dish," and Mr. MacNeil as "Iron"

were made up to represent the electric percolator, toaster, chafing dish and electric iron and the song of "The Lamp Socket," written by C. H. Peirson at Mr. Frost's suggestion, to the tune of "When I Was a Lad" from the Opera "Pinafore," was rendered verse by verse in solo and the chorus by the quartette. The words to this song were published in the issue of the Journal for May 1, 1917.

A TRIBUTE FROM THE CONTRACTOR DEALER ON THE RIVERSIDE CONVENTION

BY C. F. BUTTE

(Many beautiful expressions and sentiments have been brought out in the various reports of the organizations and individuals that attended the remarkable gathering of the electrical fraternity at Riverside. Here is a part of the report of the members of the California Electrical Contractors' & Dealers' Association who attended this gathering, which should prove an inspiration to all men of the electrical industry in the West.—The Editor.)

Man is endogenous and education is his unfolding. We love to associate with heroic persons, since our receptivity is unlimited and with great men, our thoughts and manners easily become great. Great men of our industry are thus a collyrium to clear our eyes from egotism and enable us to see other people and men and their works.

We cannot even hear of personal vigor of any kind and great power of performances without fresh resolutions on our part. The opportunity of rubbing shoulders for several days at Riverside with men, versatile, eminent, men of an intuitive habit of thought, men who stand for facts and thoughts, has made us grow like the palm, from within outward. Men like John A. Britton, H. F. Jackson, R. H. Ballard, Samuel Kahn, Stanley Walton and others with whom we came in daily contact at the Riverside convention, inhabiting high spheres of thought have unfolded and aided us to discover the nature in us. What was thus learned was delightful in the doing and the effect remains.

It remains to unfold the many possibilities before us, it remains to encourage us to higher advantages, to urge us to extend the area of life, to impel us to greater activities, and to make us grow from within outward.

We admire great men of our industry, we applaud a sufficient man, we like a master standing firm on his legs, but we find him greater when he can abolish himself, as we found our dean of industry, John A. Britton, during our convention at Riverside.

The seed is planted, the energies directed into progressive channels, the activities formulated into systematic order at the several valuable meetings during our convention will spur us to greater endeavors and efforts to make the electrical industry as a whole a haven of content and admiration.

The discussion brought forth in the meetings proved of inestimable value to all present and has proven to us that general discussion on any subject by all allied interests brings us more firmly together, benefits all mutually and brings out facts that could not and would not be brought out by any one particular branch of the industry assembled individually.

The Riverside convention has conclusively shown that the central stations, the manufacturers, the jobbers and the contractor dealers have problems and conditions to work out to adjust and to arrange mutually to the benefit and advancement of the industry as a whole, and which could not be worked out, adjusted or arranged without collective meetings similar to the Riverside convention.

The central station has many problems to solve, as was shown at Riverside, that can be materially aided by the assistance of the allied interests. The manufacturer, the jobber and the contractor dealer also have many problems that must be solved by the aid of the respective allied interests.

The contractor dealer benefitted more directly than any other interest represented at the Riverside convention and it behooves the contractor dealer to strive to meet the situation. Strive to avail himself of the many advantages and opportunities now within his grasp, strive to grow from within outward.

The resolution adopted at this convention reading in part: The member companies of the Pacific Coast Section N. E. L. A. lend active co-operation and support to the California Association of Electrical Contractors and Dealers and that a proposed plan be formulated by the commercial committee "means much to the contractor dealer." Do all the contractor dealers realize or appreciate the extent and value of this portion of the resolution "active co-operation and support?" Do all the contractor dealers realize or appreciate the extent and value of this portion of the resolution "active?" Can any contractor dealer fully appreciate the co-operative spirit displayed in the adoption of this resolution by all members of the Pacific Coast N. E. L. A.? Members of the California Association of Electrical Contractors and Dealers let us individually and collectively show our spirit in the movement to affiliate all interests together by lending our efforts and endeavors to more closely cement and bind the co-operative inclinations displayed at the Riverside convention.

TECHNICAL MEN WANTED

Men skilled in civil engineering and similar occupations wanted in the Engineer Enlisted Reserve Corps of the United States Army for war service. Skilled laborers, mechanics and artisans, miners, surveyors, draftsmen, lithographers, boatmen, electricians, and others engaged in engineering or mchanical lines in civil life wanted for enlistment in the Engineer Reserve Corps of the U. S. Army. The War Department desires to secure immediately a large enrollment of enlisted men in this corps, and suitable men are urged to make application either by mail or in person to one of the following offices: District Engineer Officer, 204 Pine street, San Francisco, Cal.; District Engineer Officer, Third District, 405 Custom House, San Francisco, Cal.; District Engineer Officer, 723 Central Building, Los Angeles, Cal.; District Engineer Officer, 602 Burke Building, Seattle, Wash.; District Engineer Office, First District, 806 Couch Building, Portland, Ore.; District Engineer Officer, Second District, 321 Custom House, Portland, Ore.; Officer in Charge, U. S. Engineer Office, Yellowstone Park, Wyo.; Assistant Engineer, U. S. Engineer Sub-Office, Eureka, Cal.

MEMORANDUM ON LECTURE COURSE FOR ENGINEER OFFICERS' RESERVE CORPS

The sixth lecture in the lecture course to prepare civilians for examinations for a commission in all branches of the Officers' Reserve Corps, delivered at Native Sons of the Golden West Building, 430 Mason street, San Francisco, Cal., was given on April 17, 1917, by Captain John B. Murphy, Coast Artillery Corps, on the subject "Administration of the United States Army." This is a topic about which there is very little definite and readable information. Captain Murphy covered the paper work of the company administration, and all the essential chapters in the Army Regulations and Service Manuals that had a vital and definite bearing on army administration. It was one of the most interesting and comprehensive lectures of the course.

The seventh lecture of the series was delivered on April 24, 1917, by Captain Richard Park, Corps of Engineers, on the subject of "Topography." The general subject of military mapping was covered by way of introduction, and without attempting to teach those present how to make a military map, the main feature of road sketching and map reading were gone into in considerable detail—the work being illustrated by having an engineer sketching outfit set up on the stage and a small detachment of engineer soldiers going through the motions directing shots, reading angles, going in contours, taking side shots, and so on, each instrument used and each phase of the work being explained while the soldiers went through the motions.

The eighth lecture was given on May 1, 1917, on the subject of "Coast Artillery Drill Regulations."

LATEST IN EVERYTHING ELECTRICAL

(New uses for electrical energies are constantly being evolved. The recent advent of the electric linotype in battleship equipment has a two-fold meaning in these days of national stress. A brief description of this interesting application follows. Other recent improvements in electrical devices may also be found in the following pages, which conclude with a book review and briefs concerning new bulletins of interest to men of the electrical industry throughout the West.—The Editor.)

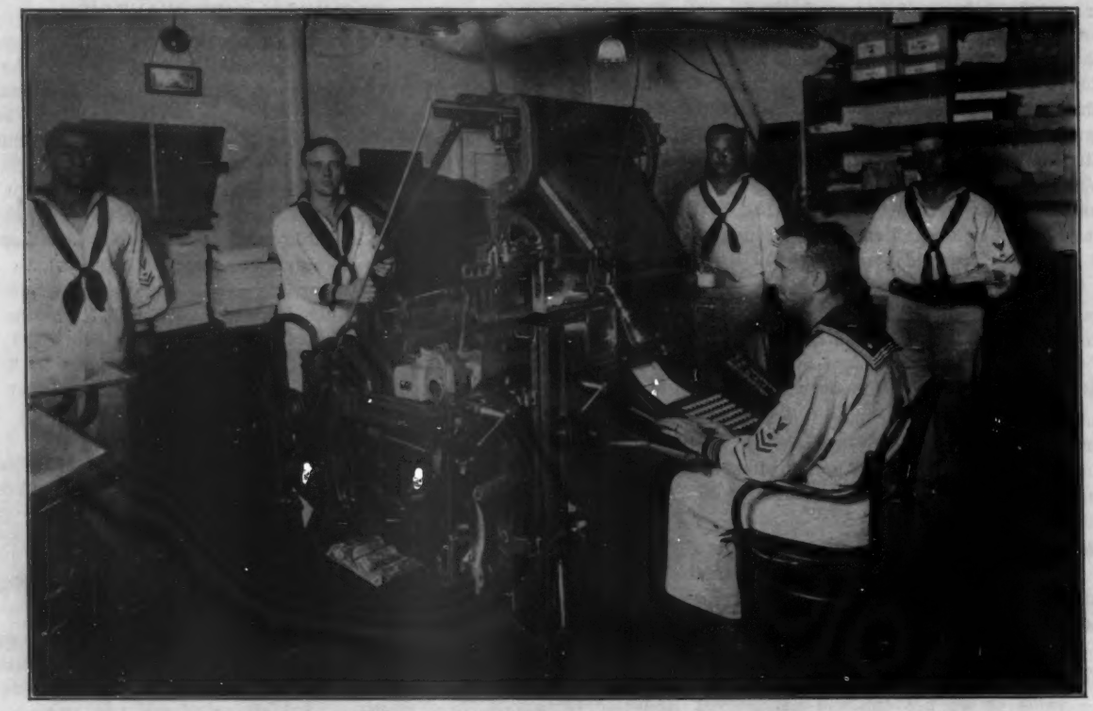
THE ELECTRIC LINOTYPE POT A GOOD CENTRAL STATION LOAD

Of the standard line of industrial heating devices, the electric linotype pot in particular has come into extensive use. There has existed of course for years back a desire to get away from the gas heated pot. Electric lighting companies, and printing and publishing houses both have investigated the electric pot. It furnishes a desirable load for the central station and is of good use to the printer because the automatic temperature regulation gives him better slugs and at the same time electric heat makes his rooms odorless. While the machine is in operation the current input is 600 watts and since these machines operate from 8 to 12 hours per day, a steady non-fluctuating load is the result and in many newspaper publishers' plants this load is between midnight and morning. When the metal is cold the input for about 50 minutes is about 1600 watts. It can readily be seen that a considerable yearly revenue is given the central station where even but a few of these electric pots are in service; as few as 20 furnishing a yearly load of over 50,000 kw.-hr.

There are many advantages peculiar to the electric principle of heating. It is primarily clean, safe, quick, economical and easily controlled, as there is an absence of open flames and the resultant products of combustion.

The bulb, the capillary tube, and operating coil are filled with mercury and sealed. The liquid expansion of the mercury causes the operating coil to move a lever to a contact, upon touching which the magnetic switch cuts off the current. As the temperature decreases the mercury contracts and the coil operating swings the lever back, closing the heating circuit. Thus, the heating current is automatically cut in and out, and the temperature of the metal held within twelve degrees above or below the mean operating point.

The New York World after a series of tests equipped their entire battery of fifty-six linotypes with the Cutler-Hammer pot. On the U. S. S. Wyoming a Mergenthaler linotype equipped with a C-H pot is installed and used in printing the Wyoming's monthly magazine, "The Coyote." A view of the printing office is shown in one of the illustrations.



"Doing it Electrically" on the U. S. S. Wyoming

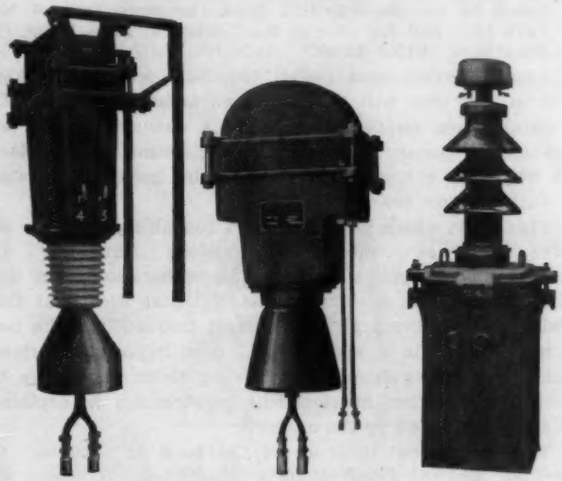
SAFETY TYPE LIGHTING PANELS

A new type of safety panel which is a distinct advance in the art of safeguarding electrical devices, even for the use of the most careless or inexperienced, has been perfected and placed on the market by the Sprague Electric Works of the General Electric Company. This panel is furnished in a steel cabinet usually having but one door. When this door is open it exposes a section showing the operating handles of branch circuit switches which are of 30 amps. 250 volts capacity, quick make and quick break tumbler type.

The "on" or "off" positions of the switch are indicated by the position of the switch handle and are marked on the handle mechanism so that "on" appears when the switch is on and "off" appears when the switch is off. This section also exposes the receptacles for plug fuses. Current carrying parts are protected under a neatly finished cover through which the switch handles and fuse receptacles protrude for operation.

OUTDOOR CURRENT TRANSFORMERS

Current transformers are employed for one or both of two purposes; to reduce the current to be measured to the relatively small values suitable for measuring instruments, relays, circuit breakers, and trip coils, or to insulate meter circuits from high line voltage. To meet the growing demand for such apparatus as a part of outdoor substation equipment, the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has developed and is marketing a



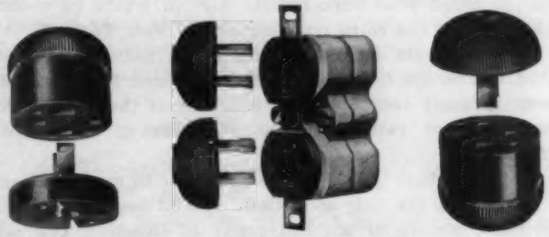
Improved Outdoor Current Transformers

complete line of outdoor current transformers for voltages up to and including 70,000 volts.

These outdoor current transformers are of two general types—dry and oil insulated. The dry type transformers are for use on circuits up to 24,000 volts. For circuits of higher voltages the oil insulated transformer is used. Both types are designed for use on from 25 to 133 cycle alternating current circuits and have a capacity rating of 50 volt amperes. They are compensated for 25 volt amperes. The dry type transformers are furnished in three styles and designated by type letters. Type MA is for voltages up to 8000, type MB for voltages of 17,000, and type MA for up to 24,000 volts. The oil insulated transformers are also furnished in three types; type OA for maximum voltages of 35,000; type OB for voltages of 47,000; and type OC for up to 70,000 volts. The primary amperage of the dry type transformers varies from 5 to 500 amperes, that of the oil insulated transformers from 5-10 to 200-400 amperes. All give a secondary amperage of 5.

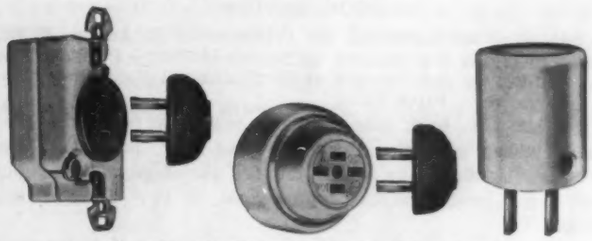
NEW C-H "STANDARD" WIRING DEVICES

Six electrical manufacturers have agreed on the making of standard plugs and receptacles, the attaching caps of which can be connected to all the bodies of the several makes. In the accompanying illustrations are shown the C-H No. 7711



New "Standard" Wiring Devices

"Standard" single flush receptacle, C-H No. 7721 duplex flush receptacle, C-H No. 7717 surface receptacle, C-H No. 7750 cord connector and C-H No. 7755 motor attachment plug, all recently brought out by The Cutler-Hammer Manufacturing Company of Milwaukee. The single and duplex flush receptacles are small, of white porcelain and rated at 660 watts, 250 volts. The portions of the receptacles exposed through the apertures in the flush plates are black enameled, making a pleasing appearance and a surface which does not show soil. Each outlet is provided with four slots holding protected contacts; two parallel to receive the blades of the "standard" parallel blade cap or polarity cap—and two in tandem to receive the blades of the tandem blade cap. Terminal screws are large and easily accessible. The duplex receptacle is the same size as the single receptacle with double the number of outlets, allowing the attachment of two electrical appliances from one outlet box, and thus providing exceptional convenience and reducing the amount of wiring and installation expense. Large terminal screws are provided, one pair taking care of both receptacles. Grooves in the side of the porcelain body accommodate the conductors and prevent crowding in the outlet box.



New Parallel Blades and Attaching Caps

The surface receptacle, like the flush receptacles, is of glazed porcelain with concealed contacts and slots arranged to accommodate standard attaching caps. It is designed for concealed wiring and has the same rating as the other receptacles. A polarity cap with parallel blades, one enlarged to fit a correspondingly enlarged slot of the standard plugs and receptacles has also been recently brought out.

The "Standard" cord connector, C-H No. 7750, and motor attachment plug, C-H No 7755, are of the separable cap type, made entirely of Thermoplax, a black heat-resisting composition, and each is rated at 10 amperes, 250 volts. The cord connector accommodates the standard parallel blade, polarity blade or tandem blade attaching caps, and is provided with four slots holding protected contacts. The motor attachment plug uses the same body and is provided with a parallel blade cap arranged for mounting on the motor. The black Thermoplax compound, of which the devices are moulded, has excellent wearing qualities, and the appearance of the knurled cap is actually improved by wear.

C-H. No. 7708 parallel current tap is another device which The Cutler-Hammer Company has recently added to its standard line. It is made of white glazed porcelain and is provided with standard Edison lamp shell. Contact blades are parallel and designed for insertion in all the standard plugs and receptacles. The current is tapped through the side of the body and the device is rated at 660 watts, 250 volts.

CLEANING UP ADVERTISING

The Advertising Club of San Francisco is now appealing to the merchants and advertisers in this city to unite with it in an effort to clean up advertising. Technical observance of the law is not sufficient to completely increase public confidence in advertising, and as advertising men we recognize that we have no right to regulate the flagrant offender—the fly by night merchant—until we have placed our own business above criticism. For instance the publishing business would be a much more satisfactory business than now if the trade abuses could be stopped. Trade abuses, fraudulent methods of doing business and misrepresentation of all kinds, are things that come within the scope of the Better Advertising Committee of the San Francisco Advertising Club.

CROCKER-WHEELER MAKES RECORD QUARTER

The Crocker-Wheeler Company of Ampere, N. J., manufacturers of electrical machinery, made record earnings for the first quarter of 1917. The dividends on both classes of stock have been earned for the year and a substantial amount added to the surplus, which is now near the million mark. The preferred stock pays 7 per cent and the common 8 per cent regularly. The company has just paid an extra dividend of one per cent on the common stock. At the present rate, the profits, after paying dividends on the preferred stock would represent $44.17 per share for the year. The "book value" of the common stock on March 31, after setting aside the dividend for the preferred stock, which is callable at 108, is $151.43 per share. This company has been constantly and quietly increasing its equipment, which is reflected in its monthly statement.

BOOK REVIEW

Preliminary Mathematics. By Professor F. E. Austin, E. E.; size 4½ by 7½ in.; 169 pp.; cloth binding. Published by the author and for sale at the Technical Book Shop, San Francisco. Price $1.20.

While this book was designed originally for the use of those whose educational training had been limited it has been so remodelled as to adopt it for use of pupils attending the eighth grade and the high school, or the "Junior High School."

The book is to be taken as a connecting link between arithmetic and algebra. It is clear and simple in its presentation and should appeal generally to anyone interested in reviewing the subject.

The "Mechanical World" Electrical Pocket Book for 1917; size 4 by 6 in.; 300 pp.; 120 illustrations; cloth binding. Published by Emmott & Company of Manchester, England, and for sale at the Technical Book Shop in San Francisco. Price $0.45.

This book is a collection of electrical engineering notes, rules, tables and data. In addition it contains blank pages for a diary and memoranda for 1917. It contains discussions on electrical measurements and testing, transmission line calculations, wiring systems and methods, electricity meters, lighting circuits and switching, and electric lamp and electric lighting. For anyone desiring a booklet to give the English point of view on such discussions, the booklet will be found valuable.

Electrical Meters. By Cyril M. Jansky; size 6 by 9 in.; 416 pp.; 314 illustrations; cloth binding. Published by McGraw-Hill Book Company, Inc., and for sale at the Technical Book Shop, San Francisco. Price $3.00.

This book which has passed through its first edition has been prepared in the extension division of the University of Wisconsin. The many new developments in electrical meter design since the publication of the first edition has necessitated the omission of some and the addition of much new material in the revised edition. The book is highly practical. Only so much of the theory of instrument transformers and other discussions is given as is necessary for an understanding of their function in connection with meters and their testing. The book should continue to receive a welcome place among students of the grade encountered in university extension work.

Theory and Calculation of Electric Circuits. By C. P. Steinmetz; size 6 by 9 in.; 361 pp.; 133 illustrations; cloth binding. Published by McGraw-Hill Book Company and for sale at the Technical Book Shop, San Francisco. Price $3.00.

In some respects this work and its companion volume, "Theory and Calculation of Electrical Apparatus," may be considered as continuations or rather parts of "Theory and Calculation of Alternating Current Phenomena." Since the original appearance of Dr. Steinmetz' works some twenty years ago, the general theory of alternating current phenomena has so vastly expanded that three separate volumes are necessary in the new revision by the author which revision is now just off the press. In this book the author has discussed the most important characteristics of the fundamental conception of electrical engineering. His works, recognized for years as classics in electrical engineering need no further description, as they will find immediate demand in all quarters.

Wiring for Light and Power. By Terrell Croft; size 5 by 8 in.; 425 pp.; 382 illustrations; pliable binding. Published by the McGraw-Hill Book Company, Inc., of New York City and for sale at the Technical Book Shop, San Francisco. Price $2.00.

Almost anyone can install electrical wiring and apparatus so that they will work in some fashion or other. But to install them so that they will be electrically safe and mechanically secure involves the application of knowledge that has been gained accumulatively by hundreds of workers during many years of practice.

This book, which is written by a consulting engineer who is the author of "American Electricians' Handbook" and other writings, supplies explanations, elaborations and illustrations for those sections of the National Electrical Code to which it is necessary to refer most frequently. The book has incorporated in it, verbatim, the most important National-Electrical-Code regulations. Following these quotations the practical application in electrical construction is explained and fully illustrated by the author.

The mechanical make-up of the book is excellent, the type clear and the illustrations well selected. It should find immediate use in the wiring field.

NEW BULLETINS

The General Electric Company has issued bulletin 44406A on GE-247 Ventilated Commutating-Pole Railway Motor.

Westinghouse Arc Lamps and Lighting Systems is the subject matter of Catalogue 7-a, just issued, consisting of 108 pages.

The Bureau of Mines has recently issued Technical paper 82 on oxygen mine rescue apparatus and the physiological effects on users of this apparatus.

The Colorado School of Mines in its quarterly publication, presents an interesting and instructive article on the civic duties and opportunities of the engineer.

The General Electric Company in bulletins 40400A and 46208 set forth its belt-driven alternators, form PB and single-phase prepayment watthour meter type 1P-5.

The Doehler Die-Casting Company of Brooklyn, N. Y., has published a sixty page book beautifully illustrated on the subject of creating an industry in the art of casting metals.

The report of the State Water Commission of California recently issued contains much interesting information relative to the use of water in that commonwealth of value both to central stations and irrigationists.

Theodore P. Shouts is distributing complimentary copies of an illustrated booklet entitled "How a Twenty Million Dollar Railroad Was Built in Mid Air" in which he recounts the building of the third tracking of the New York "L."

The California Railroad Commission asks the co-operation of the public for further effective work in its excellent bulletin recently issued on the progress of the commission's investigation of railroad grade crossings in the state of California.

"A Preliminary Study of the Alloys of Chromium, Copper and Nickel," is the title of Bulletin No. 93 just issued by the experiment station of the University of Illinois. The investigation deals especially with the growing interest in acid-resisting alloys.

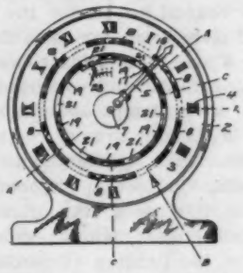
Industrial Heating as a Central Station Load which in its Part I deals with electric furnaces is an excellent booklet of thirty-two pages just published by the Society for Electrical Development, Inc., to assist central stations in building up additional profitable loads.

WHAT WESTERN INVENTORS ARE DOING

(The internal combustion engine has for half a century received the thought and attention of engineers and inventors the world over, the rapid rise of the Diesel engine being a forceful instance of this. On this page will be found a brief description of a rotary internal combustion engine recently invented by a Wetsern investigator. Other inventions by men throughout various sections of the West may also be found below.—The Editor.)

1,215,592. **Electric Controller.** Clarence Dale Vest, Martinez, Cal., assignor of one-half to Frederick A. Young, Martinez, Cal.

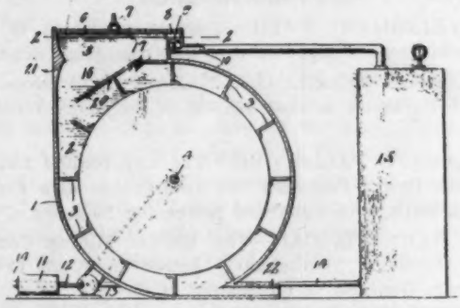
An electric controller comprising a dial of insulating material, a hand overlying the dial, clock mechanism for rotat-



ing the hand, a series of contacts on the dial arranged concentrically with respect to the center of rotation of the hand, a second series of contacts arranged concentrically with respect to the first-named series and movable circularly with relation thereto, an open electric circuit connected to the two series of contacts and means on the hand adapted to close the circuit.

1,216,184. **Rotary Internal-Combustion Engine.** Shelby P. Tierney, Metcalf, Ariz.

A rotary internal combustion engine embodying, in combination, a rotor provided with blades on its periphery, a stationary rotor casing, an explosion chamber arranged to



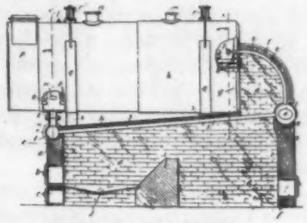
discharge into the rotor casing tangentially of the rotor, a hinged valve separating the rotor casing from the explosion chamber, a valve stem bearing a fixed relation to said valve and extending through a wall of the explosion chamber, an ignition circuit-closing arm fast on said valve stem, a circuit contact in the path of said arm, and means for holding said valve closed wth a predetermined pressure.

1,215,483. **Two-Cycle Internal Combustion Engine.** Sylvester Charles, San Jose, Cal.

An internal combustion engine, a pair of oppositely moving pistons, between which the explosive mixture is compressed and fired, a cylinder in which the pistons are disposed, the cylinder having an open end disposed in a plane at right angles to its axis and formed with an annular groove, the cylinder also having a number of circumferentially spaced intake ports leading from the groove, and a cylinder head secured in contact with the end of the cylinder and having an annular groove registering with the aforesaid groove and forming therewith a fuel heating channel, the head also having an annular fuel heating reservoir with a fuel inlet, and a plurality of circumferentially spaced ports leading from the reservoir into the channel.

1,221,028. **Steam-Boiler.** Mark R. Colby, Portland, Ore.

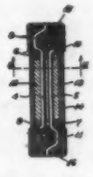
A boiler of the type described having an upper fire-tube section, the combination with the fire-tube section of a lower water-tube section comprising a transversely disposed drum located beneath the front end of the fire-tube section and spaced therefrom, a drum located at the rear end of the



fire-tube section, the drums having greater length than the diameter of the fire tube section, the lower water tube section connecting the drums along their full length and extending longitudinally beneath the fire-tube section; a connection between the lower portion of the fire-tube section and the forward drum, extension headers projecting laterally from the rear end of the fire-tube section and being in direct communication therewith, and arched water tubes connecting said rear drum with the fire-tube section approximately at the plane of the upper row of the fire tubes, the outer of the arched water tubes connecting with the extension headers.

1,221,232. **Automatic Cut-Out.** Joseph M. Sherman, Seattle, Wash.

The combination with an inclosing case made of material that is a non-conductor of electricity and having end walls of metal, of two plates of electrical insulating material transversely disposed within the inclosing case and spaced from



each other, the plates being provided each with two correspondingly spaced holes extending therethrough; two pieces of metal wire disposed to extend between the plates in lines parallel with, and spaced from, each other with their opposite end portions projected through respective ones of the holes of the adjacent one of the plates, one end portion of one of the wires being etxended to and connected with the adjacent one of the end walls and one end portion of the other of the wires being extended to and connected with the other of the end walls; and two separated masses of metal disposed within the inclosing case between the plates, each of the masses being in metallic connection with a different one of the wires; and the metal of the masses being of a character to be fusible at a low temperature.

NEW ELECTRICAL DEVELOPMENTS

(The establishment of plants for the fixation of atmospheric nitrogen has long been the dream of all interested in agricultural and industrial development of the West. The present necessity of this product for munitions of war makes this need of unusual emphasis. The announcement of the Pacific Gas and Electric Company concerning its Pit River development of an additional 180,000 horsepower together with the recent agitation to locate a nitrate plant along the Los Angeles aqueduct and utilize the power thus generated for such a purpose as that above alluded to constitutes the most interesting new electrical development of the past semi-monthly period. Other items of interest in new electrical development throughout the West may also be gleaned from the following lines.—The Editor.)

FINANCIAL

STOCKTON, CAL.—The highest price ever obtained by the South San Joaquin irrigation district for its bonds was secured when the remaining issue of $114,500 was sold to the San Joaquin Valley National Bank of Stockton for $0.97801 on the dollar. The highest price formerly obtained was $0.844.

SAN FRANCISCO, CAL.—The second mortgage 6 per cent bonds of the Petaluma & Santa Rosa Railway Company, which were due recently, after having been extended from April 1, 1915, by agreement at that date, will be cared for, according to E. H. Rollins & Sons, fiscal agents. Difficulties in meeting sinking fund provisions of the first mortgage bonds will be adjusted by getting the bondholders to waive past default, expressly on condition that provision for the release and satisfaction of the second mortgage bonds shall be made by or before March 1, 1918.

ILLUMINATION

SAN LEANDRO, CAL.—The contract for the installation of electroliers in connection with the new lighting system on East Fourteenth street has been awarded to D. A. Cantin, of Los Angeles, who bid $1908.

EAGLE ROCK, CAL.—The city engineer has been instructed to make a survey of all streets running north and south from Colorado boulevard to Hill avenue, preliminary to installation of ornamental lighting posts.

SEATTLE, WASH.—The Arrow Electric Company has been awarded the contract for the furnishing and installation of the necessary electric wiring for the power and lighting system in the new building for the Northwest Dairy Company.

OTHELLO, WASH.—At a special election of the council last night it was decided to equip a municipally-owned electric lighting plant and make necessary improvements. The cost is estimated at $14,000, which will be secured from the sale of bonds.

DOUGLAS, ARIZ.—Within five or six weeks this city will have a street lighting system, according to the statement of R. W. Arthur of the Douglas Traction & Light Company. This company has been awarded a contract for lighting G avenue.

ARCADIA, CAL.—The board of trustees has awarded the contract for the installation of 29 reinforced concrete ornamental street lighting standards, together with appurtenances, on First avenue to the Southern California Edison Company on its bids of $1400.

LOS ANGELES, CAL.—An ordinance has been passed by the city council for the improvement of Wilshire boulevard from Park View street to Arden boulevard and Park View street from Sixth to Seventh streets, by the installation of necessary appliances and furnishing of electric current.

LOS ANGELES, CAL.—The city council has ordered the necessary ornamental lighting posts and appliances to be installed and maintained and electric current to be furnished for a period of one year for the lighting of Sierra Bonita avenue between Hawthorne avenue and Sunset boulevard.

LOS ANGELES, CAL.—The federal government is seeking the use of electricity generated at Aqueduct Station No. 1 for a big nitric acid plant it is planned to start here. Petitions asking the council to tender the government of the United States the electric energy have been presented.

PASADENA, CAL.—Resolutions have been adopted by the city commissioners for the construction and installation of posts, conduits, wires, lamps and other suitable and necessary appliances in Lester avenue, between Orange Grove avenue, and Rosella Drive, together with feeder wires.

LOS ANGELES, CAL.—The city council has passed an ordinance ordering the necessary lighting posts and appliances to be installed and maintained and electric current to be furnished for the lighting of portions of Olympia boulevard, Laconia boulevard, Figueroa street, 121st street and 124th street.

NOGALES, ARIZ.—The street lighting committee has prepared a report which it will present to the city council at the next meeting. It is recommended that the city install ten 5-light clusters on lamp posts, with two circuits, said lights to be distributed along the business district at distances of about 120 ft. It is also recommended that 150 bracket lights be distributed in the residence district, not less than 200 ft. apart, these to be 100 watt globes. The estimated cost of the installation of this system is about $20,000.

TRANSMISSION

BELLINGHAM, WASH.—The school board is planning to install a power plant in the Whatcom High School.

SEATTLE, WASH.—G. W. Lawton will prepare plans for a power house to cost $35,000 at the Sedro-Woolley Hospital.

KLAMATH FALLS, ORE.—The city council has granted the Keno Power Company the right to furnish the city of Klamath Falls with light and power for 25 years.

SACRAMENTO, CAL.—The Walker Mining Company is about to develop hydroelectric power on Ward Creek, five miles from Genesee, to be utilized at the Walker mine.

TOPPENISH, WASH.—Wapato's city council has granted a 50 year franchise to the Pacific Power & Light Company for the installation and operation of light and power lines.

SUISUN, CAL.—The board of supervisors has granted a franchise to the Vallejo Electric Light & Power Company, to construct and operate along certain highways in the county of Solano.

SOCORRO, N. M.—The local interests of B. W. Hill and associates have been taken under option by Charles E. Stewart of New York, who proposes to complete a hydroelectric installation.

LOS ANGELES, CAL.—The city attorney has been instructed to prepare an ordinance providing for ornamental lights on Camino Palmero, also on Franklin avenue, between Fuller avenue and Camino Palmero.

WASHINGTON, D. C.—Secretary Lane has refused the application of the Yosemite Power Company for a permit to use the Poopenaut reservoir and incidental works and rights of way within the Yosemite National Park.

SEATTLE, WASH.—Oliver T. Erickson, chairman of the committee on public utilities, has presented a report asking for $50,000 for repairs and enlargements of central substations, and $75,000 for distribution stations.

WATTS, CAL.—The board of trustees has ordered the improvement of Elm street from Shorb avenue to Ruoff street by the installation of ornamental electric light standards with necessary conduits, wires and other appurtenances.

SAN FRANCISCO, CAL.—The contract for furnishing and delivering electric line transformers for the lower Cherry River power development, Hetch Hetchy water supply, has been awarded to the Moloney Electric Company.

SEATTLE, WASH.—The Sound Paper Company recently incorporated at Olympia with a capital of $5,000,000 is planning the establishment of a paper mill on the Sultan River. A power plant would also be established as part of the project.

PHOENIX, ARIZ.—At a meeting of the board of governors of the Water Users' Association, a contract with the Magma Copper Company, whereby the copper people will build a power plant capable of generating 600 kilowatts, was approved.

LOS ANGELES, CAL.—Floyd Brown has filed application with the State Railroad Commission for authority to install and operate an electric light and power plant in Blythe. It is stated that he has already contracted for the purchase of a plant and equipment.

KINGMAN, ARIZ.—It is stated that the finances of the Chloride X Ray Mining Company which owns the Spargo property, are successfully provided for and that a power plant will soon be installed. This will consist of a 100 h.p. engine and five drill compressors.

PORTLAND, CAL.—The Puget Sound Traction, Light & Power Company has entered into a contract with the Olympia Light & Power Company, to construct a power line from Fern Hill, near Tacoma, to the boulevard road and supply 55,000 volts of high tension power.

ST. JOHNS, ARIZ.—The board of supervisors has granted a franchise to Gustav Becker for the construction of electric light and power lines over and across public roads and highways of the towns of Springerville and Eager and other towns and places in Round Valley, Apache County.

FRESNO, CAL.—Officials of the San Joaquin Light & Power Company have decided to erect a new substation at Chowchilla; one is being built at Madera and large extensions are being made in the farming sections. The station at Henrietta is to be either enlarged or duplicated.

SPOKANE, WASH.—Construction of a high tension power line from its plant at Long Lake, 25 miles down the Spokane River, to Northport, Wash., is under consideration by the Washington Water Power Company, according to D. L. Huntington, its president. The line will be, if it is built, about 90 miles long.

PASCO, WASH.—The Pacific Power & Light Company has presented a petition to the board of county commissioners for a franchise to construct and maintain high tension electric transmission lines through Franklin County from Pasco to connect with the transmission line of the Washington Water Power Company, at Lind.

BRAWLEY, CAL.—The Southern Sierras Power Company, which holds a blanket franchise for Palo Verde Valley from Riverside County, has started building a line to Blythe, Cal. A temporary plant will be maintained until lines are brought across the mountains from Niland. The work is being superintended by P. W. Greenleaf.

HALFWAY, ORE.—A power line will be constructed from Robinette to Cornucopia and work will begin in about a month. The city council has granted the Idaho Light & Power Company a franchise to furnish electricity to the residents of the town. It was also voted to let a ten year lighting contract to the same company at the rate of $380 a year.

LOS ANGELES, CAL.—The city council has adopted a resolution covering power-bond matters. The first of these approves the temporary power contract with the Southern California Edison Company and the Pacific Light & Power Corporation and the second approves the ten-year purchase contract subject to the vote of the people on issuance of $12,000,000 in bonds.

WICKENBURG, ARIZ.—At a special election here bonds in the sum of $17,000 were authorized, of which $5000 is to be applied to the extension and betterment of the present municipal water system and $12,000 to the installation of an electric light and power plant. As soon as legal formalities are gone through the specifications for the plant will be prepared, the contract let and work started.

LOVELOCK, NEV.—Construction of a quarter million dollar 73 mile power line as well as a power plant to be built along the Truckee River near Vista, were included in the plans of the Nevada Valley Power Company announced by Vice-President and General Manager John Q. Brown. The new power plant will be to develop additional power to that secured from the plant at the government's big dam at Lahotan.

PHOENIX, ARIZ.—Residents of the Higley district have begun a campaign for the securing of electrical power for pumping for their lands. They have formed what is known as Electrical District No. 2 of Maricopa County, for the purpose. Contributions are now being asked to help defray preliminary expenses and for getting things in shape for the sale of an issue of bonds, under the direction of the board of supervisors.

SALT LAKE, UTAH.—One new power plant is to be built, two plants which have been out of commission for more than three years, put in operation and many miles of new transmission line strung at once by the Southern Utah Power Company and the Beaver River Power Company, controlled by L. L. Nunn. A high tension line from Richmond to Fillmore is included in the plan. A number of small transmission lines are to be built to other sections of Sevier, Beaver and Piute counties to care for mining companies.

WINNEMUCCA, NEV.—The Nevada Valley Power Company has started the survey for a high power electric line from Winnemucca to Golconda, and thence down Adelaide Valley, where it will connect with the main power line that is being established from Rochester to Battle Mountain. The intention of the Company is to distribute light and power through this section of Nevada. The company will also extend its power line by as direct a route as possible to Battle Mountain from Rochester. From Winnemucca it is the intention of the company to make other extensions into adjacent territory.

REDDING, CAL.—The tunnel of the Mount Shasta Power Corporation in the Big Bend of the Pit has been driven a distance of one mile, according to W. A. Cooper, general manager. Small crews are working at both ends. The aggregate length is a little over a mile. The tunnel is 7 feet high and 9 feet wide. Ultimately the tunnel will be made 17 feet wide and 19 feet high. This company will have only one tunnel, about seven miles in length. The Northern California Company's tunnel in the same region is in 700 feet. This company will have five tunnels. The intakes of the two companies on the Pit are two miles apart, but the outlets of their water tunnels will be eight miles apart.

TRANSPORTATION

SAN FRANCISCO, CAL.—Bids are being received by the board of public works for furnishing and delivering wood ties on contract No. 90, municipal railway system.

PASADENA, CAL.—Horace Dobbins gave a summary of the plans of a proposed municipal railway at a meeting of the Men's Club of Lake Avenue Congregational Church. The total cost of the proposed road is estimated at $2,500,000.

GRENADA, CAL.—The principals of the movement at Grenada have made a survey for the new electric road from Grenada to the Moffit Creek divide, and are now surveying the route by way of the Forest house, to ascertain which will be most feasible.

LOS ANGELES, CAL.—The Pacific Electric Company has more than doubled its authorized expenditure for company's shops at Torrance. Immediate appropriation for shops and equipment of $1,100,000 has been authorized by directors and officers of the company.

RIALTO, CAL.—The board of trustees has granted a franchise to the Pacific Electric Company for the construction, maintenance and operation of a five standard gauge, single track spurs and one standard gauge single track siding over, along and across certain sreets in the city of Rialto.

EAGLE ROCK, CAL.—Application has been made to the board of trustees of the city of Eagle Rock for a franchise granting the right to construct and for a period of 50 years to maintain a single track, standard gauge railroad for the purpose of carrying freight and passengers, with authority to propel cars thereover by electricity or other motor power, across Colorado boulevard between Central avenue and Bowland avenue.

TELEPHONE AND TELEGRAPH

VICTORVILLE, CAL.—General Manager Hess of the Interstate Telegraph Company plans to extend the telephone line to Bear Valley resorts this summer. The line is expected to be extended from Victorville.

WICKENBURG, ARIZ.—The district manager and the district wire chief of the Mountain States Telephone Company, have been here after the inspection of the country from Wickenburg to Parker with a view to installing a telephone line between those points.

SACRAMENTO, CAL.—Articles incorporating the Delta Telephone & Telegraph Company, which proposes to build a five-mile telephone line in Sacramento County, have been filed with the county clerk. The directors are H. W. Glensor, Scott Hendricks, E. V. Kenney, A. D. Downing and H. J. Edwards, San Francisco, and A. J. Miller, Berkeley. The company is capitalized at $350,000.

ROY, N. M.—A telephone meeting held last week at Pleasant View resulted in two rural telephone lines being planned and promoters are busy getting details of the plan completed and ready to do the work immediately. One line will run out by way of Liberty and Pleasant View to J. W. Johnson's and the other south and east of it. Twelve to fifteen phones will be on each line and will be connected with the Roy switchboard.

MESA, ARIZ.—A resolution has been adopted by the common council calling a special election to be held on May 15th, at which election bonds in the sum of $125,000 will be voted upon, for the purpose of acquiring funds for supplying the town with an artificial lighting system to be owned and controlled by the town. The issue is to consist of 250 bonds, numbered from 1 to 250, inclusive, in denominations of $500 each, dated July 15, 1917, and bearing interest at rate of 2½ per cent per annum, payable semi-annually.

IRRIGATION

VISALIA, CAL.—Engineers will begin shortly collecting data in connection with the proposed dam on Horse Creek, with which to impound the flood waters of the Kaweah River section, and of which the estimated cost has been placed at $8,000,000. Irrigation of more than 500,000 acres of land will be possible.

YREKA, CAL.—The organizers of the irrigation district for Scott Valley, have presented a petition to the board of supervisors asking that an election be called to have an irrigation district formed to comprise 40,000 acres. They plan to take the water from Scott River, which flows through the land, and carry it in a ditch that will be 20 miles in length when completed.

VICTORVILLE, CAL.—By unanimous vote the Mojave River irrigation district, embracing 27,000 acres in Apple and Victor valleys, has been formed. Directors—A. E. Hull, A. M. Byrom, Walter Paino and O. L. Morgan will at once organize and prepare the engineers plans for the development of water on the San Bernardino mountains and for a distributing system to cost about $2,000,000. A bond issue will then be submitted to voters.

ANDERSON, CAL.—Twelve carloads of mules and equipment has arrived here, being consigned to the Shattuck, Edington Company of Los Angeles. This company recently took the contract to complete the major part of the excavation work on the Anderson-Cottonwood irrigation district. Work will be begun just as soon as a camp is established and men are secured, for it is the purpose to rush the excavation so as much land as possible may be covered with water this season.

SAN FRANCISCO, CAL.—The Byron Irrigation Company of Byron, Contra Costa County, has filed with the railroad commission an application for a certificate that public convenience and necessity require it to construct and operate its system in Contra Costa, Alameda and San Joaquin counties. The reason for desiring the irrigation is that the land has become too valuable to cultivate to the ordinary annual crops, dependent wholly upon rainfall, and the rainfall has not been sufficient for several years.

KLAMATH FALLS, ORE.—The question of the organization of the Klamath irrigation project, as an irrigation district, is again receiving attenton here. The irrigation law has been enacted in law by the state legislature. As a result, several members of the board of directors of the Klamath Water Users' Association now declare for the organization of an irrigation district. It is declared that should an irrigation district be formed, local ranchers would be permitted to apply for loans under the Federal Farm Loan Act.

PORTLAND, ORE.—J. L. Stannard, consulting engineer employed by the council to report on the cost of the proposed municipal light plant, has completed his investigation and says that the project is not feasible. The reason given was that Ben Morrow, engineer for the Water Bureau, who supervised the preparation of estimates, based his cost on labor and materials on normal prices but as all materials, especially those which would enter into the construction of such a project have increased many fold, the funds asked to build the project are insufficient.

SAN BERNARDINO, CAL.—The landholders in Victor Valley have voted to form an irrigation district embracing 30,000 acres of land north of San Bernardino mountains for a reclamation project costing fully $2,000,000. The directors of the district are A. E. Hull, Walter Paine and A. M. Byron. A bond issue for $2,000,000 will be prepared immediately and the scheme will go ahead as rapidly as possible. The directors will frame up provisions for impounding the waters of the Mojave River in the east fork and submit these at the bond election within a few months.

BANNING, CAL.—W. E. Parker of Los Angeles and H. H. Merrell of South Pasadena have applied to the State Water Commissioners for permission to appropriate waters of several streams and other sources for the proposed carrying out of an extensive irrigation project. The applicants now make application to use the same waters for power purposes. Waters of Baldwin Lake, Antelope Pipes, Little Morongo, Big Morongo, Mission Snow, Tahquitz creeks and Whitewater River are specified in the application. They have also applied for permission to appropriate all of the unappropriated waters of Tahquitz Creek, Andreas Canyon Creek and West Fork of Pal Canyon Creek.